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MARSA LNG Bunkering Project, Sohar, Oman

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CONTENTS

Signature Page ii
List of Tables vii
List of Figures ix
Acronyms and Abbreviations xii

0 EXECUTIVE SUMMARY 1
0.1 Introduction 1
0.2 Regulatory and Administrative Framework 1
0.3 Project Description 2
0.4 Project Baseline Environment 5
0.4.1 Terrestrial Environment Baseline 5
0.4.2 Marine Environment Baseline 6
0.4.3 Socioeconomic. Health, Cultural and Human Rights baseline 7
0.5 Stakeholder Engagement 8
0.5.1 Engagement for the Project to date 9
0.6 Impact Assessment and Mitigation Measures 13
0.7 Framework Environmental and Social Management Plan 20

1 INTRODUCTION 1
1.1 Project Motivation 2
1.2 Project Scope 4
1.3 Area of Influence (AoI) – Environmental and Social Definition 4
1.3.1 Environmental AoI 4
1.3.2 Social AoI 4
1.4 Presentation of the proponent 7
1.5 Presentation of the consultancies in charge of the ESIA: Five Oceans and ERM 7
1.6 The ESIA Objectives 7
1.7 The ESIA Process 8
1.8 Report Structure 8

2 REGULATORY AND ADMINISTRATIVE FRAMEWORK 10
2.1 Oman Vision 2040 10
2.2 Second Nationally Determined Contribution (2021) 11
2.3 Oman National Strategy for an Orderly Transition to Net Zero (2022) 11
2.4 Political and Administrative Framework 12
2.4.1 Central Government 12
2.4.2 Regions and Governorates 12
2.4.3 Wilayat 13
2.5 National Legal Framework 13
2.5.1 Oman Environmental Protection and Administration 19
2.6 ESIA Regulatory Framework 21
2.6.1 ESIA in the Context of Regulatory Permitting 21
2.6.2 ESIA in the Context of Project Financing 21
2.6.3 ESIA Process and Approval 22
2.7 Sohar Port Industrial Area Requirements 23
2.7.1 Best Available Techniques 23
2.7.2 Industrial Safety 24
2.7.3 SIPC Policies 26
2.8 International Lender's E&S Requirements 26
2.8.1 IFC Performance Standards 27
2.8.2 EHS Guidelines (general & industry specific) 28

2.8.3 The Equator Principles ... 28
2.9 TotalEnergies' Corporate Standards ... 30

3 PROJECT DESCRIPTION ... 32
3.1 Introduction ... 32
3.1.1 Project Overview ... 32
3.1.2 Project Location ... 33
3.2 Project Schedule ... 36
3.3 Project Components ... 36
3.3.1 LNG Plant ... 36
3.3.2 Pipelines & Transmission Lines ... 43
3.3.3 Associated Facilities ... 43
3.3.4 Accommodation Camps & Other Facilities within the Area of Influence ... 45
3.4 Construction, Precommissioning and Commissioning Phase ... 45
3.4.1 Mobilisation Activities ... 46
3.4.2 Onshore Facilities Construction Activities ... 46
3.4.3 Jetty Installation ... 47
3.4.4 Condensate Export Pipeline Installation ... 48
3.4.5 Electrical Transmission Line ... 49
3.4.6 Precommissioning & Commissioning ... 50
3.4.7 Duration and Timing ... 50
3.5 Operations & Maintenance Phase ... 50
3.6 Decommissioning & Abandonment Phase ... 50
3.7 Use of Resources and Environmental Interferences ... 51
3.7.1 Land Use ... 51
3.7.2 Chemicals ... 53
3.7.3 Fuels ... 54
3.7.4 Energy ... 54
3.7.5 Water Supply and Consumption ... 55
3.7.6 Transportation & Traffic ... 56
3.7.7 Atmospheric Emissions ... 56
3.7.8 GHG Emissions ... 58
3.7.9 Noise Emissions ... 60
3.7.10 Waste Handling and Disposal ... 61
3.7.11 Effluents Management ... 64
3.8 Employment and Labour ... 66
3.8.1 Construction Phase ... 66
3.8.2 Operation Phase ... 66
3.9 Health, Safety & Security ... 66
3.9.1 Oil Spill Contingency Plan ... 66
3.10 Project Alternatives ... 67
3.10.1 Introduction ... 67
3.10.2 Location Alternatives ... 67
3.10.3 Technology and Process Alternatives ... 67
3.10.4 No-Project Alternative ... 68

4 TERRESTRIAL ENVIRONMENTAL BASELINE ... 69
4.1 Physical Environment ... 69
4.1.1 Climate and weather ... 69
4.1.2 Soil Quality ... 75
4.1.3 Groundwater ... 77
4.1.4 Surface drainage ... 77
4.1.5 Air Quality ... 77
4.1.6 Noise ... 87

4.1.7 Geological Framework ... 96
4.1.8 Landscape and Visual ... 102
4.2 Terrestrial Ecology ... 104
4.2.1 Terrestrial Ecoregions ... 104
4.2.2 Main Habitats ... 105
4.2.3 Flora and Fauna ... 105
4.2.4 Protected and Designated Areas ... 108
5 MARINE ENVIRONMENTAL BASELINE ... 110
5.1 Physical Environment ... 110
5.1.1 Bathymetry ... 110
5.1.2 Wave Climate ... 111
5.1.3 Tides ... 112
5.1.4 Currents ... 112
5.1.5 Coastal Geology ... 113
5.1.6 Coastal Sediment Transport ... 114
5.1.7 Marine Sediment Quality ... 114
5.1.8 Seawater Quality ... 116
5.2 Marine Ecology ... 116
5.2.1 Marine Habitats ... 116
5.2.2 Benthic Fauna ... 118
5.2.3 Artificial Hard Substrates ... 119
5.2.4 Fish ... 121
5.2.5 Marine Mammals ... 121
5.2.6 Sea Turtles ... 122
5.3 Marine Habitat Classification According to IFC Performance Standard 6 ... 123
5.3.1 Definitions ... 123
5.3.2 Area of Analysis ... 124
5.3.3 Habitats within the Project Area ... 124
5.3.4 Information Sources ... 125
5.3.5 Limitations ... 125
5.3.6 IFC PS6 Criteria and Definitions ... 125
5.3.7 Guidance by Criterion ... 126
5.3.8 Critical Habitat Screening ... 129
6 SOCIAL, HEALTH, CULTURAL AND HUMAN RIGHTS BASELINE ... 135
6.1 Introduction ... 135
6.2 Methodology ... 135
6.2.1 Desktop Data Collection and Review ... 135
6.2.2 Field Survey Data Collection and Assessment ... 135
6.2.3 2023 Desktop Research ... 137
6.3 General Context ... 138
6.3.1 National Context ... 138
6.3.2 Overview of Settlements in the Area of Influence ... 138
6.3.3 Local Decision Making ... 138
6.3.4 Local Governance ... 141
6.4 Planning and Development ... 141
6.5 Demographics and Settlements ... 144
6.5.1 National and Regional Population ... 144
6.5.2 Population and Settlements in the Area of Influence ... 147
6.5.3 Vulnerable Groups ... 150
6.6 Land Use and Ownership ... 151
6.6.1 Land Use ... 151
6.6.2 Land Ownership ... 151

6.7 Economy ... 152
6.7.1 National Overview ... 152
6.7.2 Human Development and Poverty ... 153
6.7.3 Governorate and local level ... 154
6.7.4 Economic Sectors ... 154
6.8 Income and Employment ... 158
6.8.1 Income ... 158
6.8.2 Employment ... 159
6.9 Livelihood Activities ... 163
6.9.1 Fisheries ... 165
6.9.2 Agriculture ... 169
6.9.3 Other livelihood activities ... 174
6.10 Infrastructure and Public Services ... 174
6.10.1 Road and Transport Infrastructure ... 174
6.10.2 Port of Sohar ... 176
6.10.3 Marine Traffic and Navigation ... 176
6.10.4 Water Resources and Use ... 177
6.10.5 Sanitation ... 179
6.10.6 Waste ... 179
6.10.7 Energy ... 181
6.10.8 Oil and Gas Infrastructure ... 181
6.10.9 Housing ... 182
6.11 Education and Skills ... 184
6.11.1 Literacy Levels ... 184
6.11.2 Education system and attainment ... 184
6.11.3 Education infrastructures ... 185
6.12 Health ... 187
6.12.1 Health Overview ... 187
6.12.2 Communicable Diseases ... 188
6.12.3 Chronic Diseases ... 190
6.12.4 Accidents and Injuries ... 191
6.12.5 Healthcare Infrastructure, Accessibility and Quality ... 191
6.12.6 Determinants of Health ... 191
6.13 Cultural Heritage ... 194
6.13.1 Regulatory Framework & International Standards ... 194
6.13.2 Overview of Cultural Heritage in Oman ... 196
6.13.3 Identified Heritage Sites within the general area ... 198
7 STAKEHOLDER ENGAGEMENT ... 200
7.1 Introduction ... 200
7.2 Stakeholder Engagement Principles ... 200
7.3 Stakeholder Identification ... 201
7.4 ESIA Consultation Activities ... 205
7.4.1 Baseline phase stakeholder engagement ... 205
7.4.2 Scoping Presentation Meeting ... 206
7.4.3 ESIA Disclosure and Consultations ... 206
7.5 Considerations for Future Stakeholder Engagement ... 215
7.6 Grievance Mechanism ... 217
7.6.1 Grievance Procedure ... 217
7.7 Monitoring and Reporting Stakeholder Engagement Activities ... 218
7.7.1 Data Management ... 218
7.7.2 Internal and external reporting ... 218
8 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT ... 220

8.1 Introduction 220
8.2 Impact Assessment Methodology 220
8.2.1 Introduction 220
8.2.2 Description of the Impact Assessment Methodology 221
8.2.3 Prediction of Impacts 222
8.2.4 Evaluation of Impacts – Planned Events 222
8.2.5 Evaluation of Impacts – Unplanned Events 228
8.2.6 Identification of Mitigation and Enhancement Measures 230
8.2.7 Residual Impact Evaluation 230
8.2.8 Management and Monitoring 231
8.2.9 Cumulative Impact Assessment (CIA) Methodology 231
8.2.10 Climate Affairs methodology 234
8.2.11 Climate Change Risk Assessment 238
8.3 Impact Identification Matrix 239
8.4 Aspects Scoped Out of the ESIA 241
8.5 Environmental Impact Assessment 244
8.5.1 Air quality (AQ) 244
8.5.2 Noise Emissions (N) 262
8.5.3 Soils 268
8.5.4 Groundwater (GW) 272
8.5.5 Surface Water (SW) 275
8.5.6 Landscape and visual (LF) 279
8.5.7 Terrestrial Ecology and Habitats (THE) 283
8.5.8 Seawater and Sediment Quality (SQ) 287
8.5.9 Marine Ecology and Habitats (ME&H) 293
8.5.10 Protected Species / Critical Habitat (PS/CH) 299
8.6 Socioeconomic Impact Assessment 304
8.6.1 Local economy and employment (EE) 304
8.6.2 Workforce Social Issues – Workers Management (WM) 309
8.6.3 Community Health, Safety and Security (CHSS) 317
8.6.4 Traffic and Transport (TT) 327
8.6.5 Community Cohesion and Expectations (CC) 331
8.7 Ecosystem Services (ES) 337
8.7.1 Ecosystem Services Screening 338
8.7.2 Impact identification and assessment 340
8.8 Climate Affairs 346
8.9 Accidental and Non-routine events 346
8.9.1 Introduction 346
8.9.2 Assessment of Unplanned Events from Terrestrial Operations. 348
8.9.3 Assessment of Unplanned Events from Marine Operations. 351
8.9.4 Mitigation measures 353
8.10 Cumulative Impacts 354
8.10.1 Introduction 354
8.10.2 Application of the RCIA methodology 354
8.10.3 Transboundary Impacts 367

9 FRAMEWORK ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN 369
9.1 Introduction 369
9.1.1 Purpose 369
9.1.2 Scope 370
9.1.3 Project Standards 370
9.1.4 Management of Change 370
9.2 MARSA LNG LLC E&P HSE Management System 371
9.3 Resources, Roles and Responsibilities 374
9.4 Commitments register 375

9.4.1 Construction phase ... 375
9.4.2 Operation phase ... 407
9.4.3 Decommissioning phase ... 422
9.4.4 Unplanned events ... 432
9.4.5 Cumulative impacts ... 434
9.5 Specific management plans and procedures ... 434
9.5.1 Traffic Management Plan ... 434
9.5.2 Water Management Plan ... 435
9.5.3 Pollution Prevention and Control Plan ... 436
9.5.4 Waste Management Plan ... 437
9.5.5 Hazardous Materials Management Plan ... 438
9.5.6 Biodiversity Management Plan ... 438
9.5.7 Marine Traffic Management Plan ... 439
9.5.8 Sediment and Storm Water Management ... 440
9.5.9 Stakeholder Engagement plan ... 440
9.5.10 Community Grievance Mechanism ... 440
9.5.11 Industrial Baseline Survey and Local Content Plan ... 441
9.5.12 Workers Management Plan ... 441
9.5.13 Occupational Health and Safety Plan ... 442
9.5.14 Community Health and Safety Management Plan ... 442
9.5.15 Social Investment Plan and Community Needs Assessment ... 442
9.5.16 Emergency Response Plan ... 443
9.5.17 Decommissioning Plan ... 443
9.6 Contractor plans and procedures ... 443
9.7 Environmental and Social Monitoring Program ... 444
9.8 Planning and Implementation ... 445
9.8.1 Training and Awareness ... 445
9.8.2 Communication ... 446
9.8.3 Documentation & Document Control ... 446
9.8.4 Operational Control ... 447
9.9 Implementation and Monitoring ... 448
9.9.1 Monitoring & Measurement ... 448
9.9.2 Reporting ... 449
9.10 Compliance Evaluations and Audits ... 449
10 REFERENCES ... 450
APPENDIX A PROJECT APPLICABLE NATIONAL LEGISLATIVE FRAMEWORK
APPENDIX B STAKEHOLDER ENGAGEMENT PLAN
APPENDIX C AIR QUALITY MODELLING
APPENDIX D CLIMATE CHANGE RISK ASSESSMENT (CCRA)
APPENDIX E RESPONSES TO SIPC COMMENTS SCOPING REPORT
APPENDIX F RESPONSES TO SIPC COMMENTS ESIA REPORT VERSION B
APPENDIX G BAT ASSESSMENT REPORT

List of Tables

Table 0-1 2019 Feedback from stakeholders....9
Table 0-2 Overview of ESIA disclosure meetings held in January 2024....11
Table 0-3 Overview of the key feedback received during the ESIA disclosure....12
Table 0-4 Summary of Impact Assessment – Construction and Commissioning Phase....14
Table 0-5 Summary of Impact Assessment – Operation and Maintenance Phase....16
Table 0-6 Summary of Impact Assessment – Decommissioning Phase....17
Table 1-1 Social Area of Influence (AoI) Settlements....5
Table 2-1 Environmental laws and their relevance to the Project....15
Table 2-2 Legislation passed ratifying international agreements....19
Table 2-3 Roles and responsibilities of the authorities involved in the environmental permitting of Project 21
Table 2-4 Anticipated activities requiring an EIA under Ministerial Decision No. 48/2017....21
Table 2-5 Permitting Process Summary (Ministerial Decision No. 48/2017)....22
Table 2-6 Summary of the Project relevant IFC Performance Standards....28
Table 2-7 Main Changes from the 2020 CCRA Guidance Note to the Latest 2023 CCRA Guidance Note....30
Table 2-8 TotalEnergies' Corporate Standards....30
Table 3-1 Land Use during the Construction Phase....53
Table 3-2 Fuel Gas Composition....54
Table 3-3 Water Consumption During the Hydrotesting....55
Table 3-4 Water Consumption in the Operational Phase....56
Table 3-5 AGRU Acid Composition....57
Table 3-6 AGRU Incinerator Characteristics and Emissions....58
Table 3-7 NRU Incinerator Characteristics and Emissions....58
Table 3-8 Expected annual GHG emissions during construction phase....59
Table 3-9 Fuel gas consumption and expected annual Scope 1 GHG emissions during operational phase (Base Case)....59
Table 3-10 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (High CO_2 Case)....60
Table 3-11 Typical Noise Power Level for the Equipment....60
Table 3-12 Typical sound power level for the equipment foreseen for the pre-commissioning Phase 61
Table 3-13 Hazardous/special waste generated during construction, precommissioning and commissioning....62
Table 3-14 Waste Production in the Operational Phase....63
Table 4-1 Wave conditions generated by cyclones offshore of Duqm....71
Table 4-2 Summary of Heavy Metal Concentrations and international limits of soil heavy metals in the Port 77
Table 4-3 Description of EA monitoring stations....78
Table 4-4 Annual summary concentration statistics of priority pollutants monitored at the EA monitoring stations for the short-term (2019-2021)....81
Table 4-5 Annual summary concentration statistics of priority pollutants monitored at the EA monitoring stations for the long-term (2019-2021)....82
Table 4-6 Concentrations of priority pollutants over 24 hours (17th – 18th April 2019)....83
Table 4-7 Maximum 24-hour average of $PM_{2.5}$ and PM_{10} at Majis station, 17th July 2018 - 31st March 2019 84
Table 4-8 Monitoring Location Coordinates....90
Table 4-9 Summary of 24-hour Noise Results....90
Table 4-10 Characteristics and Coordinates of Noise Monitoring Locations....91
Table 4-11 Noise Monitoring Results....93
Table 4-12 Species List for Al Batinah Coast IBA (Birdlife International, 2023)....109
Table 5-1 Tidal levels at Sohar Port....112

Table 5-2 Cetaceans expected to occur in coastal waters of northern Al Batinah up to the 200 m depth contour (from Oman Cetacean Database, 2020) 121
Table 5-3 Marine Turtles occurring in Oman (IUCN 2023, Baldwin and Al Kiyumi, 1996) 123
Table 5-4 Quantitative Thresholds for Application of Criteria 1 - 4 128
Table 5-5 Marine species potentially occurring within the area of analysis 129
Table 6-1 Key Human Development Indicators for Oman 144
Table 6-2 Area of Interest Settlements Population Indicators (2010) 148
Table 6-3 Population Estimates for Sohar AoI Settlements (2019) 149
Table 6-4 Population of the AoI Settlements (1 January 2023) 149
Table 6-5 Land Grants by type in North Al Batinah Governorate (2016) 151
Table 6-6 Key Human Development Indicators for Oman (2017) 153
Table 6-7 Number of Fishermen and Boats by Wilaya in 2018 165
Table 6-8 Number of Fishermen and Boats by Wilaya (2014-2018) 166
Table 6-9 Fish Landing in Tons by Wilaya (2014-2018) 168
Table 6-10 Fish Landing Value (OMR1000) by Wilaya (2014-2018) 169
Table 6-11 Number of Vessel Calls in Sohar Port (2014-2018) 176
Table 6-12 Higher Education Institutions in Sohar area 186
Table 6-13 Selected Disease Mortality Rates in Hospitals (2020 data) 188
Table 6-14 Incidence of Sexually Transmitted Infections in Oman (per 100,000 population) 189
Table 7-1 Stakeholder Category List 202
Table 7-2 Overview of ESIA disclosure meetings held in January 2024 209
Table 7-3 Overview of the key feedback received during the ESIA disclosure phase held in January 2024 212
Table 8-1 Impact Characteristic Terminology 222
Table 8-2 Impact Type Definitions 223
Table 8-3 Definitions for Likelihood Designations 223
Table 8-4 Impact Designation Definitions 225
Table 8-5 Sensitivity Criteria for Environmental and Socioeconomic Receptors 226
Table 8-6 Impact Significance 227
Table 8-7 Context of Impact Significances 227
Table 8-8 MARSA LNG LLC's Risk Assessment Matrix 229
Table 8-9 Severity of Consequence Descriptions 229
Table 8-10 Likelihood of Occurrence Descriptions 230
Table 8-11 Description of different scope emissions (MD 20/2016). 236
Table 8-12 Possible Cases Determined from Risks to the Public or Environment from Climate Change Impacts on a Project 238
Table 8-13 Impact Identification Matrix 240
Table 8-14 Aspects scoped out of the ESIA. 241
Table 8-15 Key Potential Impacts – Air Quality 244
Table 8-16 Modelling Results for LNG Start-up Operation 250
Table 8-17 Modelling Results for LNG Normal Operation 255
Table 8-18 Key Potential Impacts – Noise 262
Table 8-19 Key Potential Impacts – Soils 268
Table 8-20 Key Potential Impacts – Groundwater 272
Table 8-21 Key Potential Impacts –Surface Water 275
Table 8-22 Key Potential Impacts – Landscape & Visual 280
Table 8-23 Key Potential Impacts – Terrestrial Ecology & Habitats 283
Table 8-24 Key Potential Impacts – Seawater and/or Sediment Quality 288
Table 8-25 Key Potential Impacts – Marine Ecology and Habitats 294
Table 8-26 Key Potential Impacts – Protected Species / Critical Habitat 300
Table 8-27 Key Potential Impacts –Local Economy and Employment 304
Table 8-28 Key Potential Impacts – Workforce Social Issues – Workers Management (WM) 309
Table 8-29 Key Potential Impacts – Community Health, Safety and Security 318

Table 8-30 Key Potential Impacts –Traffic and Transport ... 327
Table 8-31 Key Potential Impacts –Community Cohesion ... 332
Table 8-32 Existing of High Importance Ecosystems Services per Habitat type ... 339
Table 8-33 Identification of impacts and risks to ecosystem services during the construction and commissioning phase ... 341
Table 8-34 Identification of impacts and risks to ecosystem services during the operation phase 343
Table 8-35 Identification of impacts and risks to ecosystem services during the decommissioning phase 345
Table 8-36 Identification of VECs ... 356
Table 9-1 Construction Phase - Mitigation measures ... 376
Table 9-2 Operation Phase - Mitigation measures ... 408
Table 9-3 Decommissioning Phase - Mitigation measures ... 423
Table 9-4 Unplanned events - Mitigation measures ... 433

List of Figures

Figure 0-1 The Project location and surrounding infrastructure ... 1
Figure 1-1 Project site and surrounding infrastructure ... 3
Figure 1-2 Project Social and Environmental Area of Influence (AoI) ... 6
Figure 2-1 Oman Vision 2040 targets (Oman Vision 2040, 2020) ... 10
Figure 2-2 Oman National Priorities (Oman Vision 2040, 2020) ... 11
Figure 2-3 Overview of the Sultanate’s Governorates ... 12
Figure 2-4 Wilayat of Liwa and Sohar in North Al Batinah Governorate ... 13
Figure 2-5 EIA Approval Process in Oman, including IFC PS led processes required by international lenders ... 23
Figure 2-6 IFC PS Framework ... 27
Figure 3-1 Project site and surrounding infrastructure ... 35
Figure 3-2 Indicative Layout of the LNG Plant ... 37
Figure 3-3 LNG Plant Flow Diagram ... 38
Figure 3-4 LNG Plant process diagram and mass balance ... 42
Figure 3-5 Pipelines and Power Cable Associated to the LNG Plant ... 44
Figure 3-6 Temporary Facilities within the LNG Site ... 47
Figure 3-7 An Example of the Jetty ... 48
Figure 3-8 Sohar Free Zone in relation to nearby areas of development ... 52
Figure 3-9 LNG Plant and Jetty drainage scheme ... 65
Figure 4-1 Mean monthly: temperature, rainfall, and wind speed (top) and wind direction (bottom) 70
Figure 4-2 Modelled cyclone surge along Duqm coastline ... 71
Figure 4-3 Tropical Cyclone GunoGonu (June 2007) ... 72
Figure 4-4 Predicted (red line) and measured (blue line) tidal height at Wudam Naval Base during the passage of cyclone Gonu ... 72
Figure 4-5 Tropical Cyclone Phet (June 2011) ... 73
Figure 4-6 Tropical Cyclone Kyarr (October 2019) ... 74
Figure 4-7 Observed Impact to coastal residential housing caused by Storm Surges ... 74
Figure 4-8 Geological Map with Sampling Locations in Sohar Industrial Port ... 76
Figure 4-9 Location of EA monitoring stations ... 79
Figure 4-10 Location of Dust Monitoring in Majis site ... 84
Figure 4-11 Continuous ambient particulate levels from July 2018 to March 2019 ... 85
Figure 4-12 Temperature Data from July 2018 to March 2019 ... 85
Figure 4-13 Relative Humidity levels from July 2018 to March 2019 ... 86
Figure 4-14 Wind speed and wind direction July 2018 to March 2019 ... 86
Figure 4-15 Noise Monitoring Location (N1) ... 89
Figure 4-16 Noise Monitoring Locations ... 92

Figure 4-17 Noise levels recorded over a 48 hour period at N1 95
Figure 4-18 Tectonic Elements Surrounding the Arabian Plate 97
Figure 4-19 Instrumental Seismicity of Oman from 1904 to 2008 98
Figure 4-20 Mean Peak Ground Acceleration (cm/s^2) in the Sultanate of Oman 99
Figure 4-21 Landslide Hazard Distribution Map 100
Figure 4-22 Tsunami Risk Assessments of Wilayats in Oman 101
Figure 4-23 Tsunami Risk Assessment Map in Oman 101
Figure 4-24 Visual Landscape of the Port from Harmul Village 102
Figure 4-25 Visual Landscape at Nearby Fishing Community. Evidence of Flaring 102
Figure 4-26 Visual Landscape of Project Site towards Southeast 103
Figure 4-27 Visual Landscape of Project Site towards the Sea 103
Figure 4-28 Visual Landscape of Project Site towards Northwest 104
Figure 4-29 Ecoregion Map of the Sultanate of Oman 106
Figure 4-30 Terrestrial and Marine Habitat Map of the Arabian Peninsula 107
Figure 4-31 Terrestrial Ecology Map of the Project Site 108
Figure 5-1 Bathymetric contours of the Sohar Port offshore area 111
Figure 5-2 ERA5 Wave Rose from Jan 2010 to Dec 2016 for Sohar Port 112
Figure 5-3 The Sea of Oman region. Dashed and dotted line demarcates the location of the Ras Al Hadd frontal zone 113
Figure 5-4 Overview of surficial sediment characteristic of the mean sediment grain size (D_{50}) 115
Figure 5-5 Final biogeographic framework: Realms and provinces. 117
Figure 5-6 Fouling Community on Majis Jetty Piles Figures 120
Figure 6-1 Overview of Settlements in the AoI 140
Figure 6-2 Surroundings of Sohar Port as of July 2023 142
Figure 6-3 Sohar Port and Freezone Map, 2023 143
Figure 6-4 Population Trends in Sohar and Liwa Wilayas (2011-2018) 145
Figure 6-5 Religious Sites in the AoI 146
Figure 6-6 Structure of Oman´s Economy (% of GDP) in 2018 152
Figure 6-7 Share of Non-petroleum Activities in Oman’s GDP (2019) 155
Figure 6-8 Number of Hotels and Guests in North Al Batinah 158
Figure 6-9 Labour Force Participation Rate by Gender 158
Figure 6-10 Unemployment Rate versus Number of Workers in North Al Batinah 162
Figure 6-11 Overview of Traditional Livelihoods in Settlements in the AoI 164
Figure 6-12 Traditional Fishing Methods Observed in the AoI 167
Figure 6-13 Restriction Zones and Fishing Grounds 168
Figure 6-14 Farm Converted to Residential Use in al Khuwairiya 170
Figure 6-15 Crop Fields in Majis Area 170
Figure 6-16 Crops cultivated in the AoI (2012-2013) 171
Figure 6-17 Animal Husbandry Activities in the AoI, (2012-2013) 172
Figure 6-18 Animal Husbandry in the Social AoI 173
Figure 6-19 Animal Husbandry Purposes in the AoI (2012-2013) 173
Figure 6-20 Small business in Majis settlement 174
Figure 6-21 Transportation Infrastructure in Oman 175
Figure 6-22 Sohar Port seen from Harmul settlement 176
Figure 6-23 Yearly Average Groundwater Change Catchment of Wadi Bani Umar 178
Figure 6-24 Groundwater Tankers in Ghadfan Settlement 178
Figure 6-25 Irrigation (*Aflaj*) Systems in Northen Oman 179
Figure 6-26 Waste Management Infrastructure in Oman 180
Figure 6-27 Waste Collection by be’ah in Harmul Settlement 181
Figure 6-28 Oman’s Major Oil and Gas Infrastructure 182
Figure 6-29 Type of Housing Facilities (Oman) 183
Figure 6-30 Examples of Housing Types in the AoI 184
Figure 6-31 Education Attainment in North Al Batinah 185

Figure 6-32 Education and Leisure Facilities in the AoI 187
Figure 6-33 Tuberculosis Incidence in Oman 2000-2016 189
Figure 6-34 Location of Main Health Facilities in the AoI 193
Figure 6-35 Map of the Region of Sohar 198
Figure 6-36 Example of Local Identified Heritage Sites 199
Figure 7-1 Public announcement in Al Shabiba newspaper on 11 December 2023 207
Figure 7-2 Public announcement in Al Shabiba newspaper on 4 January 2024 208
Figure 7-3 View of the ESIA package available in the office of the Governor of North Al Batinah 209
Figure 7-4 Stakeholder Engagement Programme 216
Figure 7-5 Grievance Mechanism Procedure 218
Figure 8-1 Impact Assessment Approach 221
Figure 8-2 Impact Assessment Process 222
Figure 8-3 Rapid CIA – Six-step process 233
Figure 8-4 ESIA climate change scope 234
Figure 8-5 Confidence levels for Ranking Project Sensitivities to Climate Change 237
Figure 8-6 Project categories as defined by the IFC 239
Figure 8-7 NO2 1-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C) 251
Figure 8-8 PM 24-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C) 252
Figure 8-9 SO_2 1-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C) 253
Figure 8-10 NO_2 1-hour Ground Level Concentrations during LNG Normal Operation (Extract from Appendix C) 256
Figure 8-11 PM 24-hour Ground Level Concentrations during LNG Normal Operation (Extract from Appendix C) 257
Figure 8-12 SO2 1-hour Ground Level Concentrations during Normal Operation (Extract from Appendix C) 258
Figure 8-13 Sohar Industrial Port in relation to nearby areas of development 359
Figure 8-14 Location of Sohar Industrial Port and surrounding industries 360
Figure 8-15 Detail of Sohar Industrial Port, Freezone and surrounding areas of development 361
Figure 9-1 TotalEnergies Health, Safety and Environment Policy 372
Figure 9-2 Organisation of the Common Principles in the plan–do–check–act improvement cycle 373
Figure 9-3 HSE MS Documentation Hierarchy for the Project 447

Acronyms and Abbreviations

Name	Description
5OES	Five Oceans Environmental Services LLC
ADCP	Acoustic Doppler Current Profiler
AGRU	Acid Gas Removal Unit
ALARP	As Low As Reasonably Practicable
AoA	Area of Analysis
AoI	Area of Influence
ASHW	Arabian Sea Humpback Whale
BAT	Best Available Techniques
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BID	Background Information Document
BOD	Biochemical Oxygen Demand
BOG	Boil Off Gas
CCRA	Climate Change Risk Assessment
CH	Critical habitat
CHA	Critical habitat assessment
CH_4	Methane
CHMP	Community Health and Safety Management Plan
CHSS	Community Health Safety and Security
CIA	Cumulative Impact Assessment
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COMAH	Control of Major Accident Hazards Regulations
CR	Critically Endangered
CSR	Corporate Social Responsibility
DGEA	Directorate General of Environmental Affairs
DWCP	Decent Work Country Programme
EA	Environment Authority (successor to MECA)
E&S	Environmental and Social
EBSAS	Ecologically or Biologically Significant Marine Areas
EC	European Commission
EEZ	Exclusive Economic Zone
EF	Enrichment Factors
EFG	End Flash Gas
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EN	Endangered species (IUCN Red List Status)
EOO	Extent Of Occurrence
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan

Name	Description
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESO	Environment Society of Oman
EU	European Union
FEED	Front End Engineering Design
FGDs	Focus Group Discussions
GAI	Geo-Accumulation Indices
GCC	Gulf Cooperative Council
GDP	Gross Domestic Product
GFOTU	General Federation of Oman Trade Unions
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GN	Guidance Note
GNI	Gross National Income
HABs	Harmful Algal Blooms
HAZID	Hazard Identification Study
HAZOP	HAZard and OPerability analysis
HDI	Human Development Index
HFC	Hydrofluorocarbon Compounds
HHC	Heavy Hydrocarbon
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HRRA	Human Rights Risk Assessment
HSE	Health, Safety and Environment
HSS	Health, Safety and security
IBAT	Integrated Biodiversity Assessment Tool
IBS	Industrial Baseline Survey
ICV	In-Country Value
ICE	Internal Combustion Engine
IED	Industrial Emission Directive
IESC	Independent Environmental and Social Consultants
IFC	International Finance Corporation
ILO	International Labour Organization
IMMA	Important Marine Mammal Areas
IPIECA	International Petroleum Industry Environmental Conservation Association
IPPC	Integrated Pollution Prevention and Control
ITA	Important Turtle Areas
IUCN	International Union for Conservation of Nature
KIIs	Key Informant Interviews
KPI	Key Performance Indicators

Name	Description
LNG	Liquefied Natural Gas
MAF(W)	Ministry of Agriculture, Fisheries and Water Resources
MAPP	Major-Accident Prevention Policy
MD	Ministerial Decisions
MDEA	Methyl Diethanolamine
MECA	Ministry of Environment and Climate Affairs
MEBS	Marine Environment Baseline Survey
MERS-CoV	Middle East respiratory syndrome coronavirus
MISC	Majis Industrial Services
MMSCFD	Million Standard Cubic Feet per Day
MoM	Ministry of Manpower
MoSD	Ministry of Sustainable Development
MRMWR	Ministry of Regional Municipalities and Water Resources
MSW	Municipal Solid Waste
MTPA	Million Ton Per Annum
N_2O	Nitrous Oxide
NCDs	Non-communicable diseases
NCSI	National Centre for Statistics and Information
NGO	Non-Government Organizations
NO_x	Oxides of Nitrogen
NO_2	Nitrogen Dioxide
NRU	Nitrogen Rejection Unit
NTI	National Training Institute
NTS	National Tourism Strategy
NTU	Nephelometric Turbidity Units
NW	North West
O_3	Ozone
OCN	Other Country Nationals
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development
OMR	Omani Rial
ONSS	Oman National Spatial Strategy
OQGN	OQ Gas Networks S.A.O.C.
OQRPI	OQ Refineries and Petroleum Industries LCC,a subsidiary of OQ
OSCP	Oil Spill Contingency Plan
PACD	Public Authority for Civil Defence
PAWR	Public Authority of Water Resources
PFC	Perfluorocarbons
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment

Name	Description
PPP	Purchasing Power Parity
PS	Performance Standard
PSA	Particle Size Analysis
QRA	Quantitative Risk Assessment
RCIA	Rapid Cumulative Impact Assessment
RD	Royal Decree
ROP	Royal Oman Police
RoW	Right of Way
SBS	Social Baseline Study
SE	South East
SEP	Stakeholder Engagement Plan
SF_6	Sulphur Hexafluoride
SFZ	Sohar Free Zone
SIPA	Sohar Industrial Port Area
SIPC	Sohar Industrial Port Company
SIZ	Sohar Industrial Zone
SMEs	Small and Medium Enterprises
SO_2	Sulphur dioxide
SPFZ	Sohar Port Free Zone
SPS	Sohar Port South
SPZ	Special Planning Zone
SSS	Side Scan Sonar
STI	Sexually Transmitted Infection
STP	Sewage Treatment Plant
SWI	Seawater Intake
TMP	Traffic Management Plan
ToR	Terms of Reference
TS	Transfer Station
UAE	United Arab Emirates
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
VECs	Valued Environmental and social Components
VOC	Volatile Organic Compound
VU	Vulnerable species (IUCN Red List Status)
WHO	World Health Organisation
WMP	Waste Management Plan

0 EXECUTIVE SUMMARY

0.1 Introduction

Marsa Liquefied Natural Gas LLC is a single integrated company owned by TotalEnergies EP Oman Development B.V. (80% equity) and Almuzn Liquified Natural Gas LLC (OQ) (20% equity).

TotalEnergies is the fourth largest publicly-traded integrated international oil and gas company in the world and employs approximately 100,000 people worldwide with operations in more than 130 countries. The company has activities in every sector of the oil and gas industry: including in the upstream (oil and gas exploration, development and production, liquefied natural gas) and downstream (refining, petrochemicals, specialty chemicals, the trading and shipping of crude oil and petroleum products, marketing). In addition, TotalEnergies operates in the power generation and renewable energy sector.

OQ is a global integrated energy company headquartered in Muscat, Sultanate of Oman. OQ operates assets and has investments in 17 countries covering the entire energy value chain from upstream, midstream to downstream refining, petrochemicals, marketing, and alternative energy.

The Project owner is proposing to develop a Liquefied Natural Gas (LNG) Bunkering Project in the Sultanate of Oman, in Sohar, to supply LNG as a fuel to marine vessels (hereafter referred to as the Project). This is planned to be achieved through the downstream development of a new 1 million Ton Per Annum (MTPA) liquefaction plant. The LNG plant will be built on land that has already been reclaimed in the Sohar Industrial Port Area (SIPA), located in the Wilaya of Liwa in the Governorate of North Al Batinah. The gas to be delivered and processed at the LNG Plant will be supplied through the OQGN network, which is Oman's exclusive gas transportation system operator. The volume of feed gas to be liquefied in the LNG Plant corresponds to MARSA LNG LLC's gas equity produced by the upstream Block 10, operated by Shell Development Oman (53.4% equity) in a joint venture involving MARSA LNG LLC (33.2% equity) and OQ (13.4% equity). Gas will be treated, liquefied, and stored onshore to provide an LNG fuelling (i.e. bunkering) service to marine vessels via a dedicated LNG marine terminal. The Project is hereafter referred to as the LNG Bunkering Project.

The Project requires permitting by the Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA) through the Sohar Industrial Port Company (SIPC) and an Environmental and Social Impact Assessment (ESIA). Five Oceans Environmental Services LLC (5OES) is an Omani registered company and has been appointed in partnership with ERM by MARSA LNG LLC to undertake the ESIA as an independent environmental consultancy.

As international financing may be required for the Project, the requirements of the IFC Performance Standards and IFC Environmental, Health and Safety Guidelines and Equator Principles have been considered in the development of the ESIA report. The requirements of the IFC Performance Standards are reflected in the impact assessment and mitigation measures presented in the ESIA, and through additional documents supporting the implementation of mitigation and management measures. The Environmental and Social Management Plan (ESMP) and individual supporting management plans for specific topics will be implemented within a robust Environmental and Social Management System (ESMS) in due course.

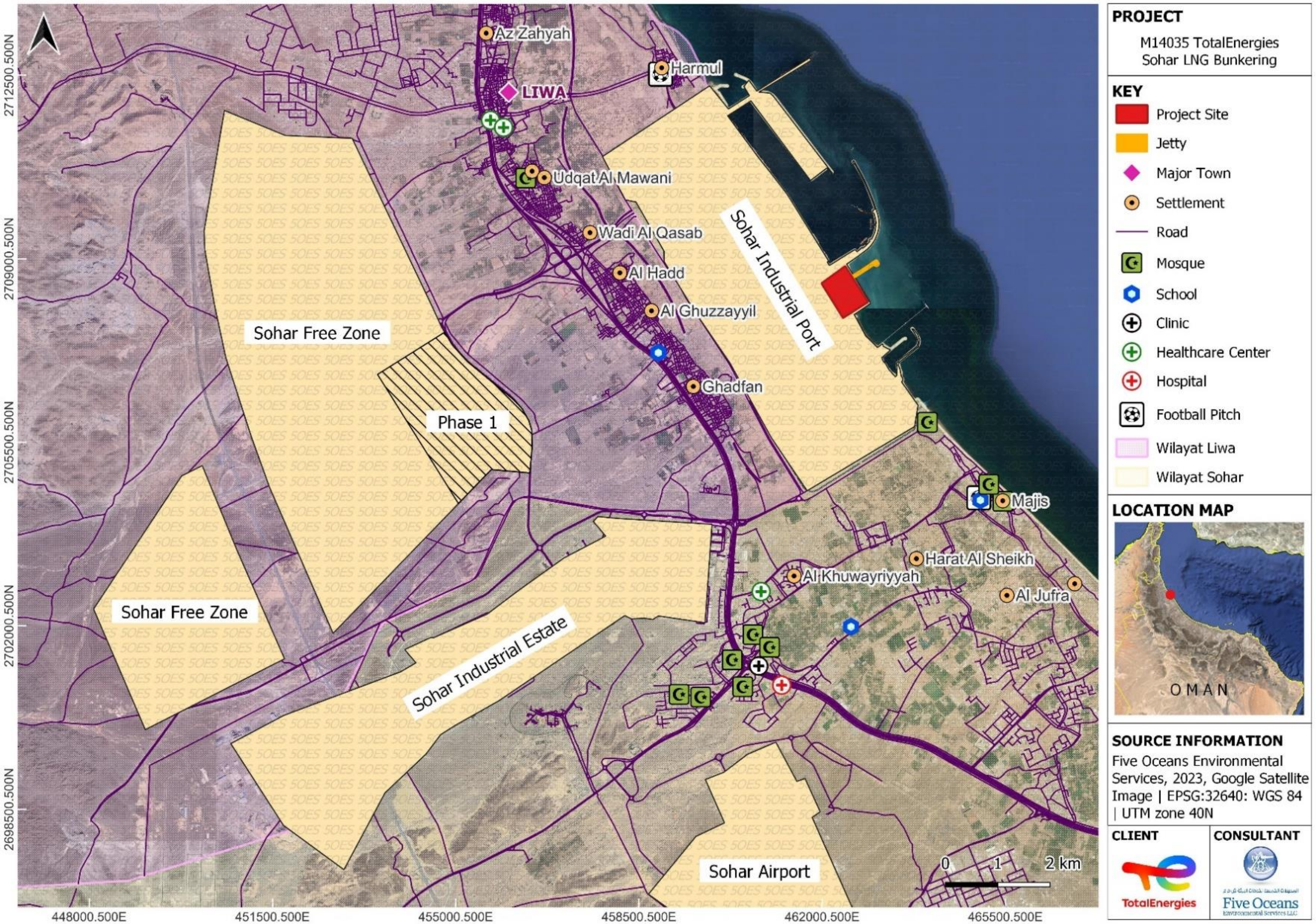


Figure 0-1 The Project location and surrounding infrastructure

0.2 Regulatory and Administrative Framework

Environmental protection within Oman is primarily governed by the *"Law for the Conservation of the Environment and the Prevention of Pollution*" (Royal Decree, RD, 114/2001) administered by the Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA). The environmental permitting process is regulated by the Authority Decision 107/2023 issued in August 2023.

In accordance with national legislation (MD 48/2017), the Project is classified as a Category 'A' activity and requires an Environmental Impact Assessment (EIA).

While the EA is the national authority with regard to EIAs in Oman, the Sohar Industrial Port Company (SIPC), through a Memorandum of Understanding with EA, has the responsibility of managing environmental related issues and overseeing the EIA process in the Sohar Port (i.e. where the Project is located). SIPC is the lead concessionaire, and its corporate policies apply (Rules and Regulations1) to the design, permitting, construction, and operation of the Project. Once approved by SIPC, the recommendation for approval is submitted to the EA which then issues the environmental permit. In addition, SIPC guidelines require the EIA to incorporate Integrated Pollution Prevention and Control (IPPC), Seveso III Criteria (Directive: 2012/18/EU), as well as best available techniques (BAT). These have been considered for this Project as Best Practise.

As international financing may be required for the Project to proceed, the IFC Performance Standards and IFC Environmental, Health and Safety Guidelines and the Equator Principles (EP4) are considered. Consequently, a Climate Change Risk Assessment (CCRA) has been prepared, aligning with the Oman Regulations for the Management of Climate Affairs and following EP4's 2023 Guidance Note for CCRA. According to EP4, for projects classified as Category A (as in this case), a Physical CCRA and a GHG Emissions Assessment are required by default, and when combined Scope 1 and Scope 2 GHG emissions are expected to exceed 100,000 tCO_2 equivalent annually, the requirement of a Transition CCRA and GHG Alternatives Analysis (AA) is triggered. As described later in the CCRA, total GHG emissions of the Project fall below this threshold; therefore, these two latter assessments are not required. It should be noted that additional CCRA phases will be undertaken for further considerations for the prospective lenders, particularly for the Physical CCRA. In addition, as established by EP4, a Human Rights Risk Assessment (HRRA) has been prepared to assess potential human rights risks that need to be taken into account by the Project throughout construction and operation phases.

In addition, TotalEnergies' corporate standards are also applied to the development of the ESIA and include:

- Environmental Impact Assessment of E&P Activities (GS EP ENV 120);
- Social Impact Assessment (GS EP SDV 102);
- Social Baseline Study (GS EP SDV 101); and
- Environmental Requirements for Projects Design and E&P Activities (GS EP ENV 001).
- Environmental Baseline and Monitoring Studies: Onshore Sites (GS EP ENV 111);
- Environmental Baseline and Monitoring Studies in Offshore and Coastal Waters (GS EP ENV 112);
- GIS Deliverables for HSE (GS GR HSE 412).

1 Guidance Note: Requirements for EIA, ER, IPPC and Seveso II (REP-147-11-DJ Guidance Note EIA IPPC); January 2011.

0.3 Project Description

The Project consists of an onshore plant treating quality gas to produce LNG, primarily dedicated to LNG bunkering activities but also to load LNG carrier vessels calling at the Sohar Port. The LNG plant will be built on reclaimed land protected by an embankment and leased by SIPC. From a design perspective, the main Project concept has been selected and the Front-End Engineering Design (FEED) has been conducted to develop the Project concept.

The Project will consist in the following key elements:

- **LNG Plant**: consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to liquefy Natural Gas and produce LNG.
- **Condensate Export Pipeline**: comprising a short pipeline (< 1 km) that will supply condensate (a by-product of the LNG Plant production) to ADVARIO's tank farm (former Oil Taking Terminal - OTT) for future use by another industry within the Sohar Port (i.e., OQ Refineries and Petroleum Industries LLC - OQRPI). Outside of MARSA LNG LLC's fence, the condensate export pipeline will cross an existing pipeline corridor within the port to reach the tank farm fence which is located approximately 100 m from the fence. The pipeline will be above ground on the existing/upgraded pipe rack. While the pipeline construction, tie-in to ADVARIO's tank farm and commissioning will be completed by an EPC Contractor of MARSA LNG, the operation and maintenance of the pipeline will be the responsibility of MARSA LNG.
- **Electrical Transmission Line**: comprising an approximately 3.5 km-long buried electrical cable that will connect the LNG substation with the existing substation operated by Oman Electricity Transmission Company (OETC) within the Sohar Port. The installation, termination, and connection between the two substations will be undertaken by MARSA LNG LLC's EPC Contractor. Operation and maintenance of the LNG substation as well as the underground transmission line will be the responsibility of MARSA LNG.
- **Topside of the LNG Export Jetty**: the jetty subsea foundation and access road will be designed and built by SIPC and is outside the Project's scope. However, the jetty topsides (operational area) will be completed by MARSA LNG LLC's EPC Contractor and is part of the Project's scope. The topside elements required for loading include a pipe rack, process manifolds, LNG loading arms, safety measures, and a jetty control station. The operation of the jetty topsides is within the Project's scope, while the substructure maintenance and mooring operations remain within SIPC's scope of work.

In addition, the following associated facilities[2] are considered for the Project:

- An extension to the **OQGN feed gas pipeline**: the existing OQGN network will be extended by approximately 2.5km, to feed the LNG Plant with natural gas up to a Receiver Station operated by OQGN nearby the LNG Plant. The pipeline extension will be buried and will run within an existing pipeline corridor within the port. The construction, operation and maintenance of the pipeline will be performed by OQ GN and is not part of the Project's scope;
- The **marine component of the Jetty**: the subsea part of the Jetty will be designed and built by SIPC and is not part of the Project's scope. As base case, it will be around 450-500 m long and equipped with a 4-m wide road. On the other hand, the jetty topsides (operational area) will be completed by the MARSA LNG LLC's EPC Contractor and is part of the Project' scope.
- A **solar plant** is planned to be constructed on a separate plot to supply power to the LNG Plant during operation. The solar plant will be connected to the grid network and from there, energy will be procured for the LNG Plant. The LNG plant will consume around 44% of the energy produced by the Solar Plant during the day through power wheeling agreements with OETC for usage of

2 Associated Facilities (AFs) to the Project are facilities (i.e. infrastructure developments) that are not funded by the Project and that would not have been constructed or expanded if the Project did not exist, and without which the Project would not be viable.

their grid network for power supply. Nighttime electricity will be procured from the OETC Grid through the same dedicated power connection. Since the Solar plant will be producing the entire energy needs of the LNG plant during the day itself, there will be an excess of around 56% during the day which will be sold on the Omani spot market. The solar plant is not part of the Project's scope, and it will be evaluated in a separate and dedicated ESIA. However, considering that it is built as an offset GHG Scope 2 emission solution for the Project, the potential cumulative impacts associated to the construction and operation of the solar plant have been assessed as part of the Project's impact assessment.

The yearly LNG Plant capacity is around 1 Million Ton Per Annum (MTPA). The gas will be delivered at the expected average rate of 150 Million Standard Cubic Feet per Day (MMSCFD) to the Plant inlet. The typical flow rate will be of 158 MMSCFD considering the LNG Plant availability.

The gas to be delivered and processed at the LNG Plant will be supplied through the OQGN network, which is Oman's exclusive gas transportation system operator. The volume of feed gas to be liquefied in the LNG Plant corresponds to MARSA LNG LLC's gas equity produced by the upstream Block 10, operated by Shell Development Oman (53.4% equity) in a joint venture involving MARSA LNG LLC (33.2% equity) and OQ (13.4% equity). The fluids produced from Block 10 are combined and processed with other production streams from different blocks at the Saih Rawl central processing plant, owned by Energy Development Oman SAOC (EDO) and operated by Petroleum Development Oman (PDO). The processed gas is then introduced into the national gas pipeline network at the processing plant's outlet, while the condensates are transported to the Muscat terminal via the Oman MOL (Main Oil Line). Block 10 achieved its first gas production milestone in January 2023, and currently sells the gas to the government through an interim Gas Sale Agreement valid until 2041. Through its 33.2% equity on Block 10, MARSA LNG LLC will have the right to take 150 MMcf/d from the domestic network to supply the LNG Plant. However, the gas that will be treated at the LNG plant will not directly come from Block 10, as different gas field feed the national gas transportation system between the Block 10 location and the Sohar port. Without MARSA LNG LLC's LNG Plant, gas produced by Block 10 would continue to be supplied to the domestic network and industrial gas consumers, including the Qalhat LNG Terminal.

As mentioned above, the feed gas will be pre-treated upstream of the LNG plant site before being delivered to the LNG plant by OQGN's existing pipeline network. Additional pre-treatment will be required at the LNG plant further refining the gas for export. Upon arrival to the inlet facility, the feed gas will flow through an inlet facility made of a series of filters to remove black powder and a let-down unit that will reduce the gas pressure and temperature. Filtered feed gas will flow through a mercury-removal unit to prevent mercury amalgam corrosion (or liquid metal embrittlement) of aluminium equipment in the cryogenic sections of the plant. Carbon dioxide (CO2) will be removed by an Acid Gas Removal Unit (AGRU) through an absorption process using an amine solution. Water will be removed to prevent hydrate and ice formation in the cryogenic section using a dehydration unit with regenerative molecular sieve beads. Heavy hydrocarbons and benzene that can freeze in the cryogenic section will be removed to produce Condensate (by-product) that will be exported through the Condensate Export Pipeline.

The LNG produced in the plant will be sent to an onshore storage tank, before being loaded to bunkering vessels or LNG carriers via a dedicated LNG marine terminal (jetty and associated LNG loading system). The construction of the subsea part of jetty is outside of the Project´s scope and will be developed by SIPC directly. While the vessel traffic for users is not part of the Project's scope, it is considered as an associated activity for the scope of the ESIA; therefore, the activities associated to marine traffic, vessel movements and operations inside the port area are part of the scope of this ESIA.

All vapours generated during loading system will be returned to the Boil-off Gas Recovery System of the facility, compressed, and send back to the LNG train.

To minimize the impact of Project site activities, a Carbon Footprint Reduction exercise has been carried out to identify GHG reduction initiatives for the Marsa LNG project. Among the solutions that have been selected at a design stage of the Project are:

- The plant has been designed as a zero-flaring plant, where all the normal flaring base line emitters (flare header purging, compressor seal gas vents) have been eliminated. In addition, the following design solutions have been considered:
  - to reduce the natural gas flaring amount, thanks to the small size of the facility and its location in a middle of an industrial area, a methodology using nitrogen has been developed. This methodology has most benefit for the initial start-up but can also be applied after every major shutdown. The methodology consists of starting up the facility under nitrogen and to perform the defrosting operations with it.
  - to achieve a zero-flaring design, Marsa LNG has implemented the recovery of its compressor seal gas for major compressors which use seal gas.
  - The design put in place will include the best-in-class passing valve design with an applied latest guidance on passing valve identification/ repair. Any identified passing valves can be repaired promptly online under temporary operating procedures.
- A thermal oxidizer has been selected to combust traces of methane remaining in the vented nitrogen of the NRU. The methane will then be converted into CO2, significantly reducing the associated emissions.
- MR refrigerant composition adjustment valves will not be routed to flare but back to the process which will also prevent flaring in case Main Cryogenic Heat Exchanger leaks develop as these will be recovered instead of being sent to flare.
- All compressors in the LNG plant will be driven by electric motors and the electricity will be drawn from the existing OETC's substation through the Electrical Transmission Line.

The Project schedule comprises the following three phases:

- *Construction, pre-commissioning and commissioning phase (Phase 1):* includes civil works, construction of buildings and installation of temporary site facilities, as well as mechanical and electrical works. The LNG Plant construction activities are planned to take approximately 34 months including pre-commissioning and commissioning phases. Currently it is foreseen that the main construction activities will start in the third quarter of 2024 and will be concluded with the start-up of the plant in mid-2027. The commissioning phase will last 15 months and will start by the first quarter of 2026.
- *Operations and maintenance phase (Phase 2*): From the LNG plant start-up, operation will commence and involve periodic maintenance activities at the Project site facilities and associated infrastructure. The design life of the LNG plant is 25 years.
- *Decommissioning phase (Phase 3)*: At the end of the planned operational lifetime, the operation of the Project facilities and associated infrastructure will be reviewed and either extended or decommissioned. Decommissioning will involve the removal and reuse / recycling / disposal of surface structures and the reinstatement and restoration of the affected sites.

During Phase 1, a maximum of 1,800 workers are expected on site during the peak of the construction activity, working 10 hours per day with overtime of 2 hours for some sections. Construction work will be implemented on a rotation or shift system basis. The workforce will consist of at least 30% Omani workers (national) while the rest will be other country nationals (OCN). Internationally recognised worker conditions, health, safety and environment standards for workers will be applied and full-time doctors and paramedics will provide 24-hour medical cover by direct presence or on call.

The predicted average number of personnel during Phase 2 is approximately 120 people. The work regime will typically be on a resident basis and a limited number of staff will be on shift basis.

The LNG Bunkering Project will make use of the existing facilities and infrastructure at the Sohar Port and Freezone Port. Some facilities will be used directly (e.g., existing accommodation camps and laydown areas or warehouses in the Freezone Port Area, the water supply network, waste and wastewater treatment facilities, and existing roads). at the Sohar Port Area. Other roads will be slightly modified in order to reach the LNG plant, including access road to the site or small modifications to the port substation in order to accommodate the new transmission line.

0.4 Project Baseline Environment

0.4.1 Terrestrial Environment Baseline

0.4.1.1 Physical Environment

The climate of Oman is typically tropical hyper-arid and Al Batinah has two distinct winter (November to April) and summer (May to October) seasons, affected by various meteorological mechanisms. Mean annual rainfall is 77 mm while summer and winter temperatures range from 20- 44 ˚C and 13-28 ˚C respectively (Meteoblue, 2019). Mean annual humidity is 56.8% and wind speeds range from 0.7 -4.8 m/s; being typically highest in winter. Storm surge and cyclone events are common and are associated with summer meteorological conditions.

The Sohar area is set within Al Batinah Coastal plains and has visual aesthetic through natural features such as wadis and low-lying hills. The industrial nature of the wider area is now however an established feature of the landscape. The Al Batinah Coastal plain lies upon the north-eastern margin of the Arabian plate and is dominated by late tertiary to quaternary fluvial deposits; extending from the interior mountains to the sea. The magnitude of seismic events in Oman range between 4 to 5 (El-Hussain et al. 2010) but no seismic events have been recorded in the Northern Batinah region.

Regional soils typically contain heavy metals such as Aluminium (Al), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), Lead (Pb), Vanadium (V) and Zinc (Zn). Within an international context, overall concentrations of heavy metals are typically low with the exception of Ni and Cd. High concentrations of Ni and Cd are attributed to weathering of ophiolite sequences (in the catchment of Sohar Industrial Port, SIP) which have a natural abundance of the minerals. Groundwater in SIP is typically shallow (< 10m) and overexploited as a potable water source. Surface drainage is typically north-west and the SIP is prone to flash flooding and high wadi water volumes. Flow is however largely deflected away from the SIP through a storm water flow system of strained wadis. Although industrialised, ambient air quality monitoring indicates that pollutant levels in SIP are below national (MD 41/2017) and international (IFC) limits for Hydrogen Sulphide (H2S), Carbon Monoxide (CO), Ammonia (NH3), Nitrogen Dioxide (NO2), Ozone (O3), dust (PM2.5, PM10) and Sulphur dioxide (SO2).

In terms of noise, the SIP is classified as an ‘industrial area’ with its surroundings falling into an ‘urban residential area’ classification (MD 79 /1994). Measured noise in the industrial area is typically below the national legislated limit of 70 dB (day, evening, and night) while average noise levels can exceed 63 dB in the urban resident area; exceeding the national legislated limit of 55, 50, and 45 dB for day, evening, and night respectively.

0.4.1.2 Ecology

The Project site will be constructed on reclaimed (unvegetated) land, zoned for industrial use which does not support any significant ecology (e.g. no endangered flora and fauna species are found in the immediate area).).

Two main vegetation types occur in the region: a community that dominates the foothills and gravel plains in Northern Oman and a community of halophytic shrubs which dominates the coastal strip.

Vegetation in the general area of the Project is dominated by Acacia tortilis trees and a variety of associated shrubs while wadis and wadi banks support a higher diversity of annual species at certain times of the year (Ghazanfar, 1999). Gravel plain and wadi habitats border the north west of Sohar Port and typically included scattered A. tortilis trees and small shrubs (*Fagonia indica*). East of the Project site (closer to the Freezone area), Ziziphus spina-christri trees can be found in the wadi channels alongside *Fagonia indica* (Ghazanfar and Fisher, 2011). Other species that are characteristic of gravel and wadi habitats that may surround the Project site include shrub species such as *Jaubertia aucheri*, two species of Goat's Head (also known as Devil's Thorn: *Tribulus terrestris* and *Tribulus omansense*), a species of thistle (*Blepharis ciliaris*), Fuzzy deutzia (*Deutzia scabra*), *Ochradeneus arabicus* (a regional endemic that is palatable for browsers), the oleander *Olea aucheri*, the shrub *Chrozophora oblongifolia* (a regional endemic) and Saxaul (*Haloxylon salicornicum*) (Ghazanfar and Fisher, 2011), In deeper wadi channels, vegetation has typically been scoured from the wadi bed by flowing water, but smaller shrubs and grasses can be densely established in these systems. Mature woodlands within the region generally consist of 8 trees/ha in the more vegetated areas of the site, with an overall average of approximately 4 trees/ha.

While the abundance of mammals is expected to be very low in the SIP, bats (likely *Rhinopoma* sp.; mouse-tailed bats) and Arabian red fox (*Vulpes vulpes*) have been observed. Herptile (reptiles and amphibians) species diversity, particularly lizards, is higher. Birds include the ubiquitous house sparrows (Passer domesticus), doves (Streptopelia spp.), yellow-vented bulbul (Pycnonotus goiavier), and purple sunbirds (Nectarinia asiatica), all of which have been seen flying between A. tortilis trees in the wadi channels. It is expected that the number of bird species in the area is substantially higher than recorded. Invertebrate presence is minimal but includes the painted lady butterfly (Vaness cardui), Arabian paper wasp (Polistes watti), grasshopper (Acrididae), potter wasp (Delta dimidiatipenne), unknown termite species, a large number of ants (Formicidae) and antlion burrows (Myrmeleontidae). Unidentified moths have been observed in regional wadis. There are no official protected areas in the vicinity of the Project however designated Important Bird and Biodiversity Areas (IBAs) are located in Khawr Shinas and Khawr Liwa approximately 5 km and 20 km North of the Project respectively. Important bird species in the Khawrs (river mouths) are predominantly Sanderling (Calidris alba) and roosting gulls and terns (Birdlife International, 2020).

0.4.2 Marine Environment Baseline

Water depth in the immediate vicinity of the SIP breakwaters is around 10 – 12 m, becoming deeper linearly towards the east. Wave fetch is limited, with winds being generally light to moderate. Under normal conditions, waves are generally small, with heights less than 1.0 m, with significant wave heights >1.5 m tending to occur only during winter 'Shamal' events, which typically last 2-5 days. The majority of waves arrive at the Port from the east, while the more extreme waves arrive from the southeast and northeast. Localised water levels around Sohar Port are governed by a combination of tidal movement and storm surge forcing as a result of low atmospheric pressure and strong winds. Surge levels are linked to seasonal variations in atmospheric pressure rather than the wind climate (WSP, 2019). During winter months (January – April), surface currents flow in a south easterly direction, in line with the movement of the Arabian Gulf water mass. During summer months (May to October), surface currents are generally reversed and are visible flowing to the northwest, with an average velocity of approximately 0.07 m/s and a maximum monthly-averaged speed of 0.13 m/s (Deltares, 2018a; WSP, 2019). Currents recorded deeper in the water column (at depths >10m below MSL) are more evenly distributed and consistent with the prevailing wind conditions each month (WSP, 2019). Long-shore transport is northwards at a rate of between 8,000m3 and 13,000m3/year (Deltares, 2007; WSP, 2019).

Following the construction of the southern and northern breakwaters in 1999, Deltares (2008) reported accretion in the southeast coastline. The greatest barrier to longshore transport of sediment are the breakwaters of the port and the contribution of the future land reclamation is considered to be negligible (WSP, 2019). Sediments in the general project area are strongly dominated by sandy sediments of fine to very fine sizes, with varying fractions of gravel, medium sand and fine sediments such as silt and clay (Halcrow, 2015; Fugro, 2017; Deltares, 2019b; WSP, 2019). Sediments are "moderately to well-sorted fine or very fine sand (2 mm to 63 µm). Sediments in the vicinity of the port are relatively unconsolidated in nature and are therefore susceptible to disturbance and erosion (WSP, 2019). Arsenic, nickel and cadmium dominate surface sediments in the SIP and are likely indicative of geological process involving ophiolite. Seawater quality in the Port area is typical of natural sea water and is considered good with respect to physico-chemical parameters and trace element composition. Turbidity typically fluctuates between 0.5 – 5 Nephelometric Turbidity Units (NTU), with short term spikes of up to 20 NTU (WSP, 2019).

0.4.2.1 Marine Ecology

The Project lies within the 'western Indo-Pacific' marine eco-region and is characterised by marine species typical of the Indian Pacific Ocean basin. Invertebrate species include rock oysters, barnacles, sponges, ascidians, and hydrozoans amongst others, which in turn provide habitats for small invertebrates such as shrimp, crabs, and worms that may be preyed upon by carnivorous fish (WSP, 2019).

The water column is capable of supporting sustained phytoplankton growth and subsequent primary production leading to Harmful Algal Blooms (HABs). HABs typically occur between January and May when large blooms of the dinoflagellate (*Noctiluca scintillans*) occur (Thangaraja et al., 2007; Goes, pers. comm.). Benthic fauna is typical of the shallow water biotopes of the northern Al Batinah coastal region and is dominated by Annelids in terms of number and species present. *Gastropod Strombus persicus* and the starfish *Astropecten sp*. are believed to be in decline since 1999 due to changing sediment surface characteristics. The Majis Jetty is colonised/fouled by sessile organisms including mixed barnacle assemblages (e.g. *Amphibalanus amphitrite*), hydroid species and bivalves. The seabed surrounding the jetty piles is characterised by infauna burrows with a thin veneer of diatoms (WSP, 2019). Fish in the wider Sohar Port area numerous and included: Black spotted butterflyfish (*Chaetodon nigropunctatus*), Pearly goatfish (*Parupeneus margaritatus*), Sergeant majors (Abedufduf vaigiensis), Picnic seabream (*Acanthopagrus berda*), Chromis (*Chromis sp*.), Snapper (*Lutjanus sp*.), Boxfish (*Ostracion syanurus*), Dotted bream (*Scolopsis ghanam*), Parrot fish (*Scarus sp.),* Goldband fusilier (*Pterocaesio chrysozona*), Cardinalfish (*Cheilodipterus sp*.) (5OES, 2016; with determinations based on Randall, 1995). Three species of cetaceans (Bryde's whale Balaenoptera brydei, spinner dolphins *Stenella longirostris* and bottlenose dolphin (*Tursiops aduncus*) occur in nearshore waters in the Sohar Port area from time to time (WSP, 2019); while Humpback Whales (*Megaptera novaeangliae*) are known to travel along the vicinity of the area, and as per a Critical habitat screening conducted, have been found to be a likely trigger of Critical Habitat. In terms of marine turtle species, the most important species likely to occur in the vicinity of the project are the hawksbill (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*), listed by IUCN as Critically Endangered and Endangered, respectively (WSP, 2019). Loggerhead turtles (*Caretta caretta*) are also endangered and have been observed in these waters in low abundance.

0.4.3 Socioeconomic. Health, Cultural and Human Rights baseline

The socioeconomic context of the Project is dominated by the Sohar Free Zone (SFZ) and the Sohar Industrial Port (SIP). The Project Area of Influence (AoI) focuses on the Project site and the surrounding area where potential direct impacts are expected to occur. The AoI has been defined to include a total of 12 villages or settlements located within 2 km of the Port area. Villages in close proximity that can potentially be directly affected by the development have been focused upon and include Majis, Ghadafan and Al Khuwairiyah, and Falaj al Qaba'il.

The socioeconomic, health and human rights context relevant to the Project have been defined based on a combination of desktop and primary information. Social baseline data collection engagement activities were conducted from October 27th to 31st and November 3rd to 6th 2019 to collect specific socioeconomic, health, and human rights data at the local level to the extent available and at the Wilaya level; and to establish initial contact with key stakeholders in Muscat and Sohar and introduce the Project. Stakeholder engagement activities consisted primarily in Focus Group Discussions, Key Informant Interviews and settlement profiling activities.

Prior to the construction of the Port, the entire area from the village of Harmul (Liwa Wilaya) in the north to Majis (Sohar Wilaya) in the south was an undeveloped rural area in which agriculture, cultivation of dates, livestock breeding, and fishing were the main economic activities. The expansion of the Sohar Port and corresponding expansion of its free zone led to rapid development of the industrial sector, mainly petrochemicals and metals, and related socioeconomic change.

The broader socioeconomic changes brought about by the development and recent expansion of the Port and associated industries include population changes in the surrounding communities with the increased presence of expatriate workers, potential changes in local culture and attitudes, as well as changes in the physical landscape and the general socioeconomic landscape of the area. In general, this has been caused by the marked shift from more traditional sectors, such as agriculture and fishing, towards industrial development.

However, despite the decline in traditional livelihoods since the establishment of the Port and in the past 10 years, fishing in particular remains an important livelihood and a primary source of income for most of the population in the coastal villages of Harmul and Majis. Farming activities have been in decline due to groundwater salinity and increasing land value in the area, and local agricultural activities are mainly focused on animal husbandry, which is mostly a supplemental source of income. Farming has been mostly replaced with public sector jobs and limited jobs in the private sector. However, in some settlements such as Al Khuwairiya farming remains the primary livelihood for farmers who are now prone to rent agricultural land in less affected areas to cultivate.

Regarding the national and local economy, due to the country’s traditional dependence on expatriate work force, in 1988 the government decided to enact the Omanisation Policy, consisting of boosting the Omani labour. The North Al Batinah Wilayat counts on high literacy rates (95%) but low rates of employment in mid-high- level positions. Based on discussions with sheikhs and community members (i.e. fishermen and farmers), locals from the area are most commonly employed as drivers or technicians (scaffolders, smelters, welders, electricians, plumbers, etc.).

With regards to health conditions, the community’s perception is that air quality degradation attributed to industrial activities in the Port has contributed to increasing incidences of asthma and respiratory illnesses and allergies. Main health infrastructure in the area includes public health centres in Falaj Al Qabail and Hallat al Sheikh as well as three private clinics. Additional private clinics and the Sohar hospital are located further away.

A desktop research of media articles and public information (excluding statistical and secondary literature sources) was conducted in July 2023 for the purpose of understanding changes in the socioeconomic context of the AoI since 2019, particularly in terms of new industries in the area and changes determined by the COVID-19 pandemic. Information collected from the 2023 Desktop Research appears to indicate that the degree of change of the AoI context has not been significant compared to the baseline presented in this report based on 2019 data collection field survey.

0.5 Stakeholder Engagement

The preparation of a Stakeholder Engagement Plan (SEP) is a key component of sustainable development and the ESIA process. Stakeholder engagement involves those stakeholders interested in or affected by a proposed development working to actively identify opportunities, risks and issues of concern. Effective stakeholder engagement and public consultation is a cornerstone of successful Project development. MARSA LNG LLC is committed to the engagement with stakeholders throughout the Project lifecycle. A Stakeholder Engagement Plan has been developed for the Project and is appended to this ESIA. This document identifies Project stakeholders, presents past engagement activities as well as the commitments of the Project owner with regard to stakeholder engagement and grievance management as the Project progresses.

For the Project, the primary objectives of stakeholder engagement are:

- To be open and transparent with stakeholders.
- To be accountable and willing to accept responsibility as a corporate citizen and to account for any potential impacts associated with Project activities.
- To have a relationship with stakeholders that is based on listening and dialogue as main pillars, as well as trust and a mutual commitment to an appropriate form of engagement.
- To respect stakeholders' interests, opinions and aspirations and ensure safe participation.
- To work collaboratively and cooperatively with stakeholders to find solutions that meet common interests and boost effectiveness.
- To be responsive and to coherently respond in good time to stakeholders.
- To be pro-active and to act in anticipation of the need for information or potential issues.
- To engage with stakeholders such that they feel they are treated fairly and their issues and concerns are afforded fair consideration based on equal human rights.
- To be accessible and within reach of stakeholders so that they feel heard and to provide comprehensive information.
- To be inclusive and proactively anticipate, identify and include all stakeholders.

Stakeholders were identified on the basis that they may influence or be impacted by the Project and would also be able to provide insight into possible issues and concerns related to the Project.

0.5.1 Engagement for the Project to date

0.5.1.1 Engagement for the ESIA baseline

Engagement as part of the baseline (integral component in the development of the ESIA report) process was conducted during the 9-day field survey from October 27th to 31st and November 3rd to 6th 2019 and was led by a combined Five Oceans and ERM Team. The purpose of the field survey was:

- To collect specific socioeconomic, health, and human rights data at the local level to the extent available and at the Wilaya level; and
- To establish initial contact with key stakeholders in Muscat and Sohar and introduce the Project.

As part of the engagement process conducted in 2019, two separate meetings with the Walis of Liwa and of Sohar and other local government representatives to disclose basic Project information and collect feedback on the Project and request baseline data were organised. Additionally, over 35 meetings with key governmental and non-governmental stakeholders at the national, regional and local levels were also organised.

The feedback provided by stakeholder in 2019 and how it has been addressed in the ESIA is provided below:

Table 0-1 2019 Feedback from stakeholders

Stakeholder issues and concerns reported in 2019	How the ESIA has addressed these?
Local economy and employment: prioritising access to employment for people (including women and youth from fishing communities) in the local Project area; expectations for local suppliers to access procurement opportunities relating to the Project; expectations for	The construction workforce is estimated to peak at 1,800 and the operations workforce is estimated at 120 people. Goods and services will be sourced locally, where possible. The ESIA has assessed impacts on economy and employment as **Positive – ESIA Chapter 8.6.1**. The Impact Assessment and Mitigation

Stakeholder issues and concerns reported in 2019	How the ESIA has addressed these?
Omani people employees by contractors during construction to access employment during operation;	Measures of this Executive Summary presents the results of the impact assessment and mitigation measures.
Fishing: Loss of fishing grounds determined by environmental pollution, land reclamation and Port extension	The construction of the Sohar Port in the early 2000s in the Wilaya of Liwa resulted in the loss of fishing grounds corresponding to the Port's concession area and restriction area (3 km into the sea and 7 km wide), as well as fishing grounds along the beach in the nearshore area where the Port was built. The LNG Plant will not result in additional restrictions to fishing or navigation and therefore no additional impacts on fishing livelihoods are expected.
Community Cohesion: Concerns that the increase in population of expatriate workers can affect community cohesion and increased demand for social services.	The ESIA has assessed impacts on Community Cohesion and Expectations in **Chapter 8.6.5**. The Impact Assessment and Mitigation Measures of this Executive Summary presents the results of the impact assessment and mitigation measures.
Environment and Health: Concerns relating to potential Project impacts, including air quality impacts related to processing of the gas, increase in cumulative emissions, etc. Community perception is that air quality degradation due to industrial activities in the Port has contributed to increased incidences of asthma and respiratory illnesses and allergies in local communities. Waste management was also cited as a major concern regarding the Project.	The maximum concentration levels of air pollutants are confined within the LNG plant site whilst the closest receptors are located more than 2 km from the LNG plant, which is sufficiently far to not be reached by any significant concentrations of the modelled pollutants. The waste facilities operators are assumed to have sufficient capacity to treat waste without causing disruption to local communities. The Impact Assessment and Mitigation Measures of this Executive Summary presents the results of the impact assessment and mitigation measures.
Community Investment: The Project is expected to consider Oman LNG in Sur as a benchmark project for good CSR and local employment practice and for MARSA LNG LLC's to follow the same targets for CSR investment (i.e. 1 to 1.5% of revenue). Expectations that the Project assigns a percentage of revenues and royalties to social projects benefiting local communities. Expectations that local communities (and vulnerable groups) closer to the coast receive support from the Project to balance out some of the perceived negative environmental impacts of the Port operations affecting them (i.e., air pollution, odour, seawater pollution, groundwater salinity, etc.).	The ESIA has assessed impacts on Community Cohesion and Expectations in Chapter 8.6.5. The Impact Assessment and Mitigation Measures of this Executive Summary presents the results of the impact assessment and mitigation measures.
Stakeholder Engagement: Expectations that engagement with local communities, Sheiks, and the Walis continues after the start of construction and throughout the Project's lifecycle. Recommendation to establish a Committee with community and government representatives from each Wilaya through the Wali's office to facilitate communication and participation in the Project.	A Stakeholder Engagement Plan is in place for the Project (Appendix B to the ESIA) and it presents commitments around stakeholder engagement throughout the entire Project lifecycle. The Project will appoint a CLO to serve as interface between the Project and local stakeholders, including communities. The CLO's role and responsibilities will include oversight of day-to-day community and stakeholder engagement activities and responsibility for interfacing between the stakeholders and the Project including its Contractors.

0.5.1.2 ESIA Disclosure

The final ESIA Report (version C), as updated in 2023, in English language along with a Non-Technical Summary in Arabic language, was made available to stakeholders and general public for a period of 39 calendar days (from 11 December 2023 to 18 January 2024). The disclosure was facilitated through electronic access via a link [https://totalenergies.com/oman/marsa-lng-project-environmental-and-social-impact-assessment-esia], accessible through a QR code, as well as through hardcopies. The availability of the ESIA report for public consultation was announced through two announcements posted in the Al Shabiba newspaper, in Arabic language.

In addition to the disclosure in electronic form, one hardcopy of the ESIA Report (version C) in English, ten hardcopies copies of the NTS in Arabic, fifty hardcopies of the feedback form in Arabic, a sheet displaying the QR code for electronic access to the ESIA, a poster to attract attention and indicate the availability of materials, a box of fifty ballpoint pens, and a feedback collection box were made available at each of the following locations: Wali Office in Liwa and Wali Office in Sohar and in the Office of the Governor of North Al Batinah. Other means by which stakeholders could provide feedback included:

- Using feedback forms which will be available to participants in the public meetings.
- Calling or sending WhatsApp messages to the phone number: 00968 9200 8157, during the entire ESIA disclosure period;
- Electronic communication, via email at esia.grm@totalenergies.com, during the entire disclosure period.

Anonymous feedback was also accepted.

Six meetings were held on the 8th and 9th of January 2024 to discuss the Project and the ESIA.

Table 0-2 Overview of ESIA disclosure meetings held in January 2024

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
Monday, 8th January 2024					
11:00 – 12:30	Omani Women Association building, Liwa	Informal meeting	Omani Women's Association – Liwa	15 (all women)	Meeting attended exclusively by women
13:00 – 15:00	Lathaeth Sohar, Sohar	Informal meeting	Youth/ Charity Groups of Sohar and Liwa	5 (no women)	
18:30 – 20:00	Omani Women Association building, Sohar	Informal meeting	■ Omani Women's Association – Sohar	2 (all women)	Meeting attended exclusively by women
20:30 – 22:00	AL-Moazzeb Jordanian, Sohar	Informal meeting	Fishermen community of Sohar and Liwa	5 (no women)	Meeting organised after the 'Isha prayer (Islamic prayer) and to allow for people to travel to the venue
Tuesday, 9th January 2024					
08:30 – 10:30	Wali's office, Liwa	Formal meeting	■ Wali of Liwa, ■ Representatives of the Majlis Ashura ■ Representatives of Liwa municipal council	9 (no women)	

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
			■ Sheikhs of communities in the Project's area of influence		
11:30 – 13:30	Majan Hall, Sohar	Formal meeting	■ Deputy Wali of Sohar, ■ Representatives of the Majlis Ashura ■ Regional offices of concerned ministries: Environmental Department of North Al Batinah Government, Head of Labour Affairs North Al Batinah, Head General of Health Services North Al Batinah ■ Sheikhs of communities in the Project's area of influence	11 (no women)	

Source: ERM and 5OES, January 2024

During the disclosure process, a total of seven written feedback forms were received, out of which two in Liwa and five in Sohar. Additional feedback was received through Whatsapp and included two employment applications. No feedback was received via email or phone.

Feedback collected during the ESIA disclosure was similar to that collected during the ESIA baseline and is presented in Table 0-3 below.

Table 0-3 Overview of the key feedback received during the ESIA disclosure

Topic	Description of feedback
Employment	Stakeholders in all meetings mentioned their expectations that the Project should prioritise employment local job seekers from the wilayats of Liwa and Sohar. Expectations also referred to access to long-term employment opportunities.
Environmental, Health and Social Impacts	Stakeholders shared concerns about the potential negative impacts of the Project such as the presence of flare and the potential impact of gas emissions on air quality, potential gas pipe leakage and the risk of explosions, or odour. Stakeholders also used the opportunity of the ESIA disclosure meetings to raise general concerns which were perceived to be attributable to the current industrial operations within the Sohar Industrial Port Area (SIPA). Examples included perceived increased incidence of health issues, such as cancer and miscarriages, reporting of deposition of white powdery residues on cars, trees, noise from industrial activities and operations including but not limited to jetty hammering and flaring, waste impacting local villages. The participants claimed that the industrial operations in the SIPA are adversely impacting fishing activities, particularly in Harmul, located approximately 200 meters from the port.

Topic	Description of feedback
	There was a demand for increased transparency of the environmental monitoring results associated to industrial operations within the Sohar Industrial Port Area to local neighbouring communities.
Project Social Investment and Responsibility	Social investment initiatives from Sohar port companies are perceived to be very small compared to the companies' revenue. Expectations in terms of access to benefits from the Project were raised by the majority of stakeholders who complained. Benefits should be directed to impacted villages around SIPA, particularly Harmul and Ghadhafan, without involving intermediaries or third parties. Requests were made for the Project to support the local community, including fishermen, sports clubs and charity teams as well as the OWA in Liwa and to prioritise partnerships with local SMEs.
Stakeholder Engagement	Feedback from fishermen conveyed a sense of unfulfilled expectations and engagement fatigue. Grievances were expressed regarding the direct impacts of previous companies' operations within the SIPA, including issues such as noise from jetty hammering, cracks in the houses, and building damage. Requests were made to maintain the communities informed about the economic contributions of companies operating within the SIPA.
Grievance mechanism	Participants commented on the online feedback form, stating it cannot be instantly filled online and suggested that the process should be simplified. They recommended making the form more user-friendly, possibly allowing for real-time online submissions, to encourage more responses from the local community.

Details about how the feedback of the ESIA disclosure process has shaped this version D of the ESIA are included in Section 6.3 of the Stakeholder Engagement Plan, included as Appendix B to the ESIA.

0.6 Impact Assessment and Mitigation Measures

The Project's potential impacts have been assessed according to their significance and the implementation of the preventive and mitigation measures, resulting in residual impacts. The identification of the impacts has been based on the potential interaction (i.e., potential impact) between specific Project activities and an environmental or social and health receptor or resource (e.g. terrestrial and marine ecology, noise, groundwater, surface water, economy and employment, community health and safety, etc.).

The following impact assessment matrix has been used:

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The assessment of potential impacts generated by the Project has been conducted on the three following phases:

- Construction, pre-commissioning and commissioning
- Operation and maintenance; and
- Decommissioning.

Table 0-4, Table 0-5 and Table 0-6 below present a summary of the identified impacts, and significance of impacts before and after mitigation measures resulting from the Project activities. Note that impacts on climate affairs, ecosystem services, unplanned events and cumulative impacts have been assessed using a different methodology and so results are not shown in the below summary tables. These are addressed and evaluated in the impact assessment chapter of this ESIA Report.

Table 0-4 Summary of Impact Assessment – Construction and Commissioning Phase

Description of Impact	Significance of the impact (prior to mitigation measures)	Residual impact Significance
AQ1 - Reduced ambient air quality caused by vehicles and machinery involved in construction activities	Minor	Minor
N1 – Noise emissions from construction activities	Minor	Minor
S1 - Soil degradation and contamination during construction works	Negligible	Negligible
GW1 – Groundwater degradation and diversion from excavation and spillage of hazardous material during construction.	Negligible	Negligible
SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction.	Negligible	Negligible
L1 – Reduced landscape aesthetic from material laydown area and dust generation during construction.	Negligible	Negligible
THE1- Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material during construction.	Negligible	Negligible
SQ1 – Degradation of marine environment quality from material transport by sea, construction and commissioning activities and materials	Negligible	Negligible
ME&H1 – Degradation of marine habitat quality and ecosystem function from construction activities.	Negligible	Negligible
PS/CH1 – Impacts to protected species and critical habitat from underwater noise and ship strikes.	Negligible	Negligible
EE1 - Temporary direct and indirect employment opportunities	Positive	Positive
EE2 - Temporary economic impacts from taxes and fees, procurement and worker spending	Positive	Positive
WM1 – Workers' Rights	Moderate	Minor
WM2- Child Labour in the supply chain	Moderate	Minor
WM3- Forced Labour in the supply chain	Moderate	Minor
CHSS1 – Safety Risks due to Increased Marine Traffic and vessel collisions	Moderate	Minor
CHSS2 - Impacts on Environmental Health - Air Quality degradation	Moderate	Minor

Description of Impact	Significance of the impact (prior to mitigation measures)	Residual impact Significance
CHSS3- Increased transmission of communicable diseases	Moderate	Minor
CHSS4- Increased pressure on health care	Moderate	Minor
TT1- Disruption to existing road users on local roads during construction	Minor	Minor
CC1 – Disturbance from presence of workforce	Minor	Negligible
CC2 - Influx of Non-Local Workers and Opportunity Seekers	Minor	Negligible
CC3- Unmet expectations of benefits	Moderate	Minor

Table 0-5 Summary of Impact Assessment – Operation and Maintenance Phase

Description of Impact	Significance of the impact (prior to mitigation measures)	Residual impact Significance
AQ2 - Reduced ambient air quality caused by LNG start-up activity	Minor	Minor
AQ3 - Reduced ambient air quality caused by LNG normal operations	Minor	Minor
AQ4 - Reduced ambient air quality caused by vessel loading activities	Minor	Minor
N2 – Noise emissions from LNG operations	Minor	Minor
S2 - Soil contamination during operation and maintenance phase	Negligible	Negligible
GW2 – Groundwater degradation from operational hazardous material spills.	Negligible	Negligible
SW2 – Contamination of storm water runoff from waste and hazardous material spills.	Negligible	Negligible
LF2 – Reduced landscape aesthetic during operations.	Minor	Minor
THE2 - Disruption to terrestrial ecology and habitat from waste, noise and air emissions, and flaring during operation.	Moderate	Minor
SQ2 – Degradation of seawater and sediment quality as a result of vessel and jetty operations, and storm water runoff	Negligible to Minor	Negligible
ME&H2 – Degradation of marine habitat quality and ecosystem function from operation activities.	Negligible to Minor	Negligible
PS/CH2 – Impacts to protected species and critical habitat from underwater noise and ship strikes	Minor	Negligible
EE3 - Long-term direct and indirect employment opportunities	Positive	Positive
EE4 - Long-term economic impacts from taxes and fees, procurement and worker spending	Positive	Positive
WM4 – Workers' Rights	Moderate	Minor
WM5- Child Labour in the supply chain	Moderate	Minor
WM6- Forced Labour in the supply chain	Moderate	Minor
CHSS5 - Safety Risks due to Increased Marine Traffic and vessel collisions	Moderate	Minor
CHSS6 - Impacts on Environmental Health - Air Quality degradation	Moderate	Minor
CHSS7- Increased transmission of communicable diseases	Moderate	Minor
CHSS8- Increased pressure on health care	Moderate	Minor
TT2- Disruption to existing road users on local roads during operations	Negligible	Negligible
CC4 – Unmet expectations of benefits	Moderate	Minor

Table 0-6 Summary of Impact Assessment – Decommissioning Phase

Description of Impact	Significance of the impact (prior to mitigation measures)	Residual impact Significance
AQ5 - Reduced ambient air quality caused by vehicles and machinery involved in dismantling activities	Minor	Minor
N3 - Noise emissions from dismantling equipment	Minor	Minor
S3 - Soil degradation and contamination during decommissioning	Negligible	Negligible
GW3 – Groundwater degradation and diversion from excavation and spillage of hazardous material during decommissioning.	Negligible	Negligible
SW3 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during decommissioning	Negligible	Negligible
LF3 – Reduced landscape aesthetic from material laydown area and dust generation during decommissioning.	Negligible	Negligible
THE3 - Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material decommissioning	Negligible	Negligible
SQ3 – Degradation of seawater quality due to vessel operations and storm water run off	Negligible	Negligible
ME&H3 – Degradation of marine habitat quality and ecosystem function decommissioning activities	Negligible	Negligible
PS/CH3 – Impacts to protected species and critical habitat from underwater noise and ship strikes	Negligible	Negligible
EE5 - Temporary direct and indirect employment opportunities (primarily unskilled)	Positive	Positive
EE6 - Temporary economic impacts from taxes and fees, procurement and worker spending	Positive	Positive
WM7 – Workers' Rights	Moderate	Minor
WM8- Child Labour in the supply chain	Moderate	Minor
WM9- Forced Labour in the supply chain	Moderate	Minor
CHSS9- Increased transmission of communicable diseases	Moderate	Minor
CHSS10- Increased pressure on health care	Moderate	Minor
TT3-Disruption to existing road users on local roads during decommissioning	Minor	Minor
CC5 – Unmet expectations of benefits	Moderate	Minor

MARSA LNG LLC shall implement the following measures to mitigate the impacts identified and presented in the tables above:

- With regard to air quality:
  - Air emission specifications in compliance with best practice and legal requirements will be considered during all equipment selection and procurement;
  - Available fuels with minimum sulphur content will be used;

  - Regular maintenance (as per manufacturers recommendations) of vehicles, machinery, and equipment in order to minimise the generation of air pollutants;
  - Flaring will only occur during the start-up, shut down and in emergency situations, entailing the plant to be zero-flaring plant during normal operations, where all the normal sources of flare gas have been eliminated in the design stage. Emissions from flaring during the initial start-up will be reduced with the use of nitrogen;
  - Atmospheric emissions from all transport vehicles used during the different phases of the Project will be reduced by minimizing the number of journeys as far as possible; and
  - A solar plant is planned to be constructed as an offset solution to fully compensate the GHG Scope 2 emissions of the LNG plant. It will be constructed on a different plot and will be the subject of its own EIA process.
- With regard to noise:
  - Develop and implement a traffic management plan to minimise as far as practicable noise generated by construction traffic;
  - Develop and implement an appropriate vehicle and equipment maintenance program;
  - Use of best available technologies and implementation of industry best practices;
  - Install equipment for noise reduction (i.e., mufflers) and minimise machinery noise (turn off machines when they are not in use);
  - Reduce use of noise generating equipment during holiday and night-time and locate said equipment as far as possible from receptors; and
  - Noise will be monitored during the construction phase (including in sensitive receptors such as Majis village) to provide an extended profile of ambient noise at the project boundary and at receptors. Noise monitoring will be carried out during the subsequent operation and decommissioning phases.
- With regard to terrestrial ecology and habitats:
  - Develop and implement waste management plan defining measures to reduce, re-use, collect, manage, recycle and dispose of waste in an appropriate manner and in accordance with good international practice
  - MARSA LNG LLC shall engage with SIPC to develop and implement a biodiversity management plan that includes a bird monitoring programme to assess the effect of flaring though engagement with SIPC and other industries carrying out flaring in the SIP area and put in place appropriate mitigation measures.
  - Develop and implement emergency response plan including response measures in the event of any leaks and spills;
  - Lighting levels will be minimised, eliminating unnecessary lighting and use proper orientation of lighting to reduce nightglow and the visibility of the LNG plant.
  - Avoid start-up/shutdown flaring at night and minimise lighting levels.
- With regard to marine ecology and habitats:
  - Develop and implement, a pollution prevention and control management plan including management of hazardous materials, and MARSA LNG LLC shall engage with SIPC to implement a biodiversity management plan that includes a ballast water management and an alien invasive species management and monitoring plan;

  - The biodiversity plan should also involve a system for approaching ships to report whale sightings, temporary and localised speed restriction zones on approach, training and awareness raising about identifying sensitive species and the issue of ship strikes;
  - MARSA LNG LLC shall engage with SIPC to maintain correct storage, treatment and disposal of operational facility and vessel waste water streams and discharges, including storm water systems; and
  - MARSA LNG LLC shall engage with SIPC with regards to the environmental standards and procedures applied to the LNG terminal operations and to Sohar Port generally, including: the establishment of "low power propulsion zones" and management of wildlife collisions.
- With regard to health, safety and security:
  - Safety Risks due to increased marine traffic and vessel collisions, Increased transmission of communicable diseases and Increased pressure on health care, applicable to construction and operation phase;
  - MARSA LNG LLC shall engage with SIPC to develop and implement a workers management plan, a community health and safety management plan, a traffic management plan, a stakeholder engagement plan and a marine traffic management plan.
- With regard to community cohesion and unmet expectations in terms of accessing Project benefits:
  - Develop and implement a stakeholder engagement plan and a grievance mechanism, a workers management plan, a social investment plan and community needs assessment.
- With regard to local economy and employment:
  - Develop and implement a Detailed Industrial Baseline Survey (IBS) and a Local Content and Procurement Plan to maximize workforce, goods and services on the Project and develop capacity among the employees and the local suppliers;
  - Develop and implement a stakeholder engagement plan and grievance mechanism.
- With regard to workers management:
  - Workers' rights, child labour and forced labour in the supply chain, applicable to construction and operation phases;
  - Develop and implement an occupational health and safety plan, workers management plan, workers grievance mechanism and stakeholder engagement plan.
- With regard to cumulative impacts:

  \- To mitigate the cumulative effects on the physical, biological and socioeconomic environment derived from the development of several projects in a given area, MARSA LNG LLC will use their best efforts to engage other developers, governments, and other stakeholders by acknowledging the cumulative impacts and risks and suggesting coherent management strategies to mitigate them.
- With regard to accidental related impacts (uncontrolled loss of containment at the LNG plant or a spill offshore):
  - MARSA LNG LLC will develop and implement an Emergency Response Plan (ERP) that will provide guidelines related to emergency management and response which can be deployed by MARSA LNG LLC when a significant incident or accident has occurred, or is likely to occur, during project operations.

0.7 Framework Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) which in an integral component of the ESIA Report, provides the framework to support the implementation of the mitigation and preventive measures identified in the ESIA process. The specific objectives of the Framework ESMP are to:

- Document the more general aspects of MARSA LNG LLC approach to environmental and social management,
- Describe how the project's environmental and social impacts will be minimised and mitigated and positive impacts enhanced during project planning and implementation,
- Detail the programme that will monitor and report the project's effects and its compliance with regulatory and corporate requirements,
- Provide a framework for the development of detailed implementation plans by contractor(s).

Furthermore, the ESMP provides outlines of specific management plans that will be detailed and operational prior to the starting of the activities, in order to address potential environmental and social impacts. In addition, MARSA LNG LLC will implement a Management of Change procedure, in order to identify gaps and uncertainties and to take them into account when they arise. The objective of the procedure is to ensure that the impacts of change are identified and assessed prior to changes being implemented.

Based on the impact assessment, the following specific management plans will be developed for the Project, following the ESIA stage:

- Traffic Management Plan;
- Water Management Plan;
- Pollution Prevention and Control Plan;
- Waste Management Plan;
- Hazardous materials management plan;
- Biodiversity management plan;
- Sediment and storm water management plan;
- Stakeholder Engagement Plan (already in place, to be further updated as the Project progresses);
- Community Grievance Mechanism;
- Industrial Baseline Survey and Local Content Plan;
- Workers' Management Plan;
- Occupational Health and Safety Plan;
- Community Health and Safety Management Plan;
- Social investment benchmarking and community needs assessment;
- Emergency Response Plan; and
- Decommissioning Plan.

The following plans will be established through engagement with SIPC and other tenants where applicable: Biodiversity Management Plan, the Ballast Water Management Plan, the Alien Invasive Species Management Plan and the Marine Traffic Management Plan as these refer to marine traffic, vessel movements and operations inside the port area. In addition, the development of plans such as health and safety plans and the influx management plan be carried out with the support of government to mitigate cumulative impacts.

In addition, environmental, social and health monitoring activities will be carried out during the whole life of the Project. The basis and guidelines for monitoring activities shall be defined at every stage of the Project cycle and will aim to provide reference to evaluate the effectiveness of the implementation of environmental management plans and any needs for improvements in these plans, in an effort to minimize the significant negative impacts.

An Offshore Environmental Monitoring Plan (jetty and vessels loading or bunkering activities), Onshore Environmental Monitoring Plan (LNG Plant) will be prepared to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts.

1 INTRODUCTION

Marsa Liquefied Natural Gas LLC is a single integrated company owned by TotalEnergies EP Oman Development B.V. (80% equity) and Almuzn Liquified Natural Gas LLC (OQ) (20% equity).

TotalEnergies is the fourth largest publicly-traded integrated international oil and gas company in the world and employs approximately 100,000 people worldwide with operations in more than 130 countries. The company has activities in every sector of the oil and gas industry: including in the upstream (oil and gas exploration, development and production, liquefied natural gas) and downstream (refining, petrochemicals, specialty chemicals, the trading and shipping of crude oil and petroleum products, marketing). In addition, TotalEnergies operates in the power generation and renewable energy sector.

OQ is a global integrated energy company headquartered in Muscat, Sultanate of Oman. OQ operates assets and has investments in 17 countries covering the entire energy value chain from upstream, midstream to downstream refining, petrochemicals, marketing, and alternative energy.

The Project owner is proposing to develop a Liquefied Natural Gas (LNG) Bunkering Project in the Sultanate of Oman, in Sohar, to supply LNG as a fuel to marine vessels (hereafter referred to as the Project). This is planned to be achieved through the downstream development of a new 1 million Ton Per Annum (MTPA) liquefaction plant. The LNG plant will be built on land that has already been reclaimed in the Sohar Industrial Port Area (SIPA), located in the Wilaya of Liwa in the Governorate of North Al Batinah. The gas to be delivered and processed at the LNG Plant will be supplied through the OQGN network, which is Oman's exclusive gas transportation system operator. The volume of feed gas to be liquefied in the LNG Plant corresponds to MARSA LNG LLC’s gas equity produced by the upstream Block 10, operated by Shell Development Oman (53.4% equity) in a joint venture involving MARSA LNG LLC (33.2% equity) and OQ (13.4% equity). Gas will be treated, liquefied, and stored onshore to provide an LNG fuelling (i.e., bunkering) service to marine vessels via a dedicated LNG marine terminal. The Project is hereafter referred to as the LNG Bunkering Project (see Figure 1-1).

The Project requires permitting by the Environmental Authority (EA) through the Sohar Industrial Port Company (SIPC) and an Environmental Impact Assessment (EIA). Five Oceans Environmental Services LLC (5OES) is an Omani registered company and has been appointed in partnership with ERM by MARSA LNG LLC to undertake the EIA as an independent environmental consultancy.

As international financing may be required for the Project to proceed, the requirements of the IFC Performance Standards and IFC Environmental, Health and Safety Guidelines and Equator Principles (EP4) have been considered, and the EIA is thus hereafter referred to as an Environmental and Social Impact Assessment (ESIA). International standards will be incorporated through the impact assessment and mitigation developed in the ESIA, and through additional documents supporting the implementation of mitigation and management measures.

In addition, a Climate Change Risk Assessment (CCRA) has been prepared, aligning with the Oman Regulations for the Management of Climate Affairs and following EP4’s 2023 Guidance Note for CCRA. According to EP4, for projects classified as Category A (as in this case), a Physical CCRA and a GHG Emissions Assessment are required by default, and when combined Scope 1 and Scope 2 GHG emissions are expected to exceed 100,000 tCO_2 equivalent annually, the requirement of a Transition CCRA and GHG Alternatives Analysis (AA) is triggered. As described later in the CCRA, total GHG emissions of the Project fall below this threshold; therefore, these two latter assessments are not required. It should be noted that additional CCRA phases will be undertaken for further considerations for the prospective lenders, particularly for the Physical CCRA. In addition, as established by EP4, a Human Rights Risk Assessment (HRRA) has been prepared to assess potential human rights risks that need to be taken into account by the Project throughout construction and operation phases.

The Environmental and Social Management Plan (ESMP) and individual supporting management plans for specific topics will be implemented within a robust Environmental and Social Management System (ESMS) in due course.

1.1 Project Motivation

At a national level, the Project is aligned with Oman's vision to diversify fuel sources and its international commitments on climate change to control growth of greenhouse gas (GHG) emissions[3]. Furthermore, Oman Vision 2040[4] (see Section 2.1) provides national targets and priorities that shape the country's regulatory and administrative framework. The LNG Bunkering project is aligned with these targets, including but not limited to:

- Oman's environmental performance index is likely to be enhanced through the diversification of fuel sources (i.e. reduced reliance on 'dirtier' fuels[5] with higher sulphur content, reduce GHG emissions).
- Private sector employment, global competitiveness, and Oman non-oil GDP (Gross Domestic Product) contribution targets will similarly be helped through the Project by increasing the service offering of the Sohar Port to facilitate the following national priorities:
  - Economic leadership and management;
  - Labour market and employment; and
  - Private sector investment and international co-operation.

From a local perspective, LNG fuel can improve the economic and environmental sustainability of shipping and facilitate growth within Oman. Finally, the Project is aligned with current industrial operations in the Sohar Port Industrial Area (SIPA) and will enhance the economic service offering of the Port. Provision of LNG as a fuel for the international maritime shipping industry will reduce reliance on other fuels and facilitate compliance with local and international air emission standards.

3 Government of Oman's UN's individually Declared National Contribution (INDC) as part of the Paris Agreement. Oman will control its expected GHG emissions growth by 2% (below BAU) to be 88714 Gg (in 2030) during the period from 2020 – 2030.

4 Oman Vision 2040[4] (approved in 2020, put into action as of early January 2021 and will remain in force till 2040) (https://www.oman2040.om/vision-en.html)).

5 Marine diesel fuel, and marine gas oil.

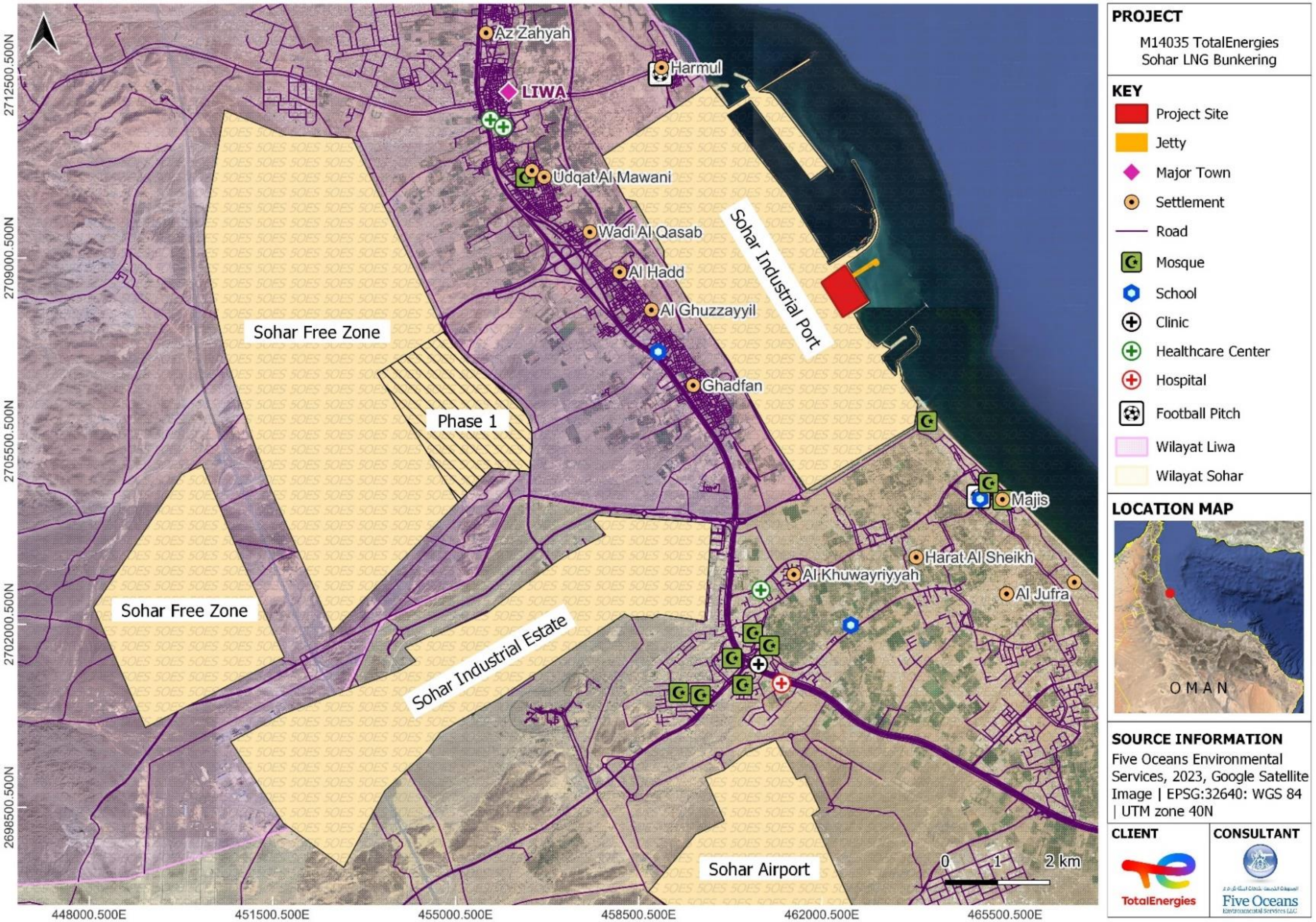


Figure 1-1 Project site and surrounding infrastructure

1.2 Project Scope

The scope of this ESIA relates to the construction and operation of an onshore plant treating a pipeline quality gas to produce Liquefied Natural Gas (LNG), primarily dedicated to provide LNG bunkering fuel to marine transportation carriers at Sohar Port. It includes several Project elements and activities, as summarised below and detailed further in Section 3.

- LNG Plant;
- Condensate Export Pipeline;
- Electricity Transmission Line;
- Topside of the LNG Export Jetty. It should be noted that the subsea part of the Jetty will be designed and built by SIPC and is not part of the Project' scope.

1.3 Area of Influence (AoI) – Environmental and Social Definition

The Project site is located in the Sohar Industrial Port, specifically in the Sohar Port South development which falls in the Wilaya of Liwa in the North Al Batinah Governorate in Al Batinah Region.

The area of influence has taken into account the following factors:

- Physical extent of the proposed works, as defined by the scheme design;
- Nature of the baseline environment and the manner in which the impacts are likely to be propagated; and
- Pattern of governmental administrative boundaries, which provide the planning and policy context for the project.

1.3.1 Environmental AoI

The environmental Area of Influence (AoI) for the project includes the site itself and the surrounding area where potential direct environmental impacts and risks are anticipated. Specifically, the environmental AoI has been defined to include a buffer of 2 km around the LNG site and the jetty, as presented in Figure 1-2 (dotted green line). This AoI encompasses the Project components, ancilliary facilities, and the expected spatial extent of potential environmental direct impacts from long-term operation.

1.3.2 Social AoI

The social Area of Influence (AoI) for the Project includes the site itself and the surrounding area where potential direct social impacts and risks are anticipated. In addition, since the scope of the baseline study also looks at indirect impacts at the regional and national levels, a broader study area has been extended beyond the immediate social AoI to include relevant socioeconomic and Human Rights context at the Wilayat, Governorate, regional and national levels, as appropriate.

The social AoI has been defined to include a total of 12 villages or settlements located within a 2-Km radius of the Port, although focus has been placed primarily on those villages that may be more directly affected by the development due to their proximity, namely Majis, Ghadafan, Al Khuwairiyah and Falaj al Qaba'il.

The extent of the social AoI was initially determined based on preliminary bibliographic research and has been updated in light of field survey results that identified a number of socioeconomic sensitivities identified in these 12 villages, as well as economic dependences and social linkages.

The list of AoI settlements and their administrative boundaries is provided in Table 1-1 below. Figure 1-2 shows the direct social AoI for the Project, while the map insert shows the boundaries of the Wilayat of Sohar and Liwa which are considered as part of the broader study area.

Table 1-1 Social Area of Influence (AoI) Settlements

Governorate	Wilaya	Settlement	Distance from the Project
Norther Al Batinah	Sohar	Majis	3.7 km
	Sohar	Al Khuwairiyah	3.7 km
	Sohar	Falaj al Qaba'il	4.9 km
	Liwa	Ghadfan	3.2 km
	Liwa	Al Ghuzayyil	3.3 km
	Liwa	Al Hadd	3.9 km
	Liwa	Wadi al Qasab	4.6 km
	Liwa	Uqdat al Mawani	5.3 km
	Liwa	Al Mukhaylif	5.8 km
	Liwa	Liwa	7.6 km
	Liwa	Hallat Al Sheikh	4.9 km
	Liwa	Harmul	5.2 km

Source: ERM, 2023.

Source: ERM, 2023.

Figure 1-2 Project Social and Environmental Area of Influence (AoI)

1.4 Presentation of the proponent

Marsa Liquefied Natural Gas LLC is the proponent (Project owner), a single integrated company owned by TotalEnergies EP Oman Development B.V. (80% equity) and Almuzn Liquified Natural Gas LLC (OQ) (20% equity).

TotalEnergies is the fourth largest publicly-traded integrated international oil and gas company in the world and employs approximately 100,000 people worldwide with operations in more than 130 countries. The company has activities in every sector of the oil industry: including in the upstream (oil and gas exploration, development and production, liquefied natural gas) and downstream (refining, petrochemicals, specialty chemicals, the trading and shipping of crude oil and petroleum products, marketing). In addition, TotalEnergies operates in the power generation and renewable energy sector.

OQ is a global integrated energy company headquartered in Muscat, Sultanate of Oman. OQ operates assets and has investments in 17 countries covering the entire energy value chain from upstream, midstream to downstream refining, petrochemicals, marketing, and alternative energy.

1.5 Presentation of the consultancies in charge of the ESIA: Five Oceans and ERM

The ESIA has been developed by Five Oceans from its offices in Oman, in partnership with ERM from its offices in Spain, Italy and France.

Five Oceans Environmental Services LLC and Five Oceans Consulting (together ‘Five Oceans’) are principle-led internationally-focused provider of specialized environmental consultancy services. Five Oceans deliver survey, monitoring, environmental assessment and environmental management studies for multi-sectoral coastal and marine developments internationally, with a particular strength in the Middle East. Five Oceans have company-registered offices in Oman and UK providing comprehensive and responsive environmental services.

ERM is a leading global provider of environmental, health, safety, risk, social consulting services and sustainability-related services. ERM has more than 160 offices in over 40 countries and territories employing more than 8,000 people. ERM works extensively for a number of oil and gas companies for both exploration and operation activities. ERM’s QHSE Management System is certified against ISO 9001 (quality), ISO 14001 (environment) and OHSAS 18001 (health and safety) standards.

ERM operates exclusively in the environmental, social and health fields and the vast majority of its clients are private industrial clients or public sector clients of an industrial nature. ERM’s experience covers numerous sectors, particularly oil and gas, mining and power.

1.6 The ESIA Objectives

The purpose of the ESIA is to document the potential effects of the Project and recommend measures to manage and monitor those effects. The main objectives are:

- To define the scope of the Project and the potential interactions of Project activities with the natural and social (including socio-economics and health) environment that will be assessed;
- To assess applicable national and international legislation, standards and guidelines, to allow for the various stages of the proposed Project to take into consideration the requirement of Omani legislation and MARSA LNG LLC’s Health Safety Social Environment and Security policy and standards along with internationally accepted environmental guidelines;
- To provide a description of the proposed Project activities and the existing physical, biological, socio-economic and human environment that these activities may interact with.
- To assess the potential environmental and social impacts resulting from the Project activities and identify viable and practical mitigation measures and management actions that are designed to avoid, reduce, remedy or compensate for any significant adverse environmental and social

impacts and, where practicable, to maximize potential positive impacts and opportunities that may arise due to the Project; and

- To provide the means by which the mitigation measures will be implemented and residual impacts managed, through the provision of an Environmental and Social Management Plan (ESMP).

1.7 The ESIA Process

This ESIA Report follows the completion of a Scoping Report that was submitted to SIPC on the 20th of January 2020. The Scoping Report provided a description of the baseline environment, a description of the stakeholder engagement for data collection undertaken at the time of writing, and a preliminary appraisal of the potential impacts of the Project. The terms of reference (ToR) of the ESIA were provided in the Scoping Report, presenting the range of issues to be addressed in the ESIA process with regards to the baseline desktop studies and field surveys and to the scope of the ESIA Report.

A meeting was held between MARSA LNG LLC, 5OES, ERM and SIPC on the 22nd of January 2020 to discuss the results of the Scoping exercise.

Following the Scoping exercise, an ESIA report was prepared incorporating comments from SIPC provided on the Scoping Report (Appendix E of the ESIA) and those provided to the ESIA following their review (Appendix F of the ESIA). In 2021, the ESIA report was not approved by EA since TotalEnergies' project timelines changed due to several reasons including project design, the COVID pandemic, among others. The Project was officially put on hold in March 2021 and reactivated early 2023.

The main Project changes since 2021 include the following which have been considered in this updated version of the ESIA:

- The Project's location, which was originally planned to be in a future reclaimed land within the industrial area of Sohar, has changed to an already reclaimed land (still within the industrial area of Sohar) located approximately 500 m away from the original area. The size of the reclaimed land itself is smaller (44.5 ha) than the original plot which was 45.0 ha.
- With the change of location, the layout of the plant (which will now occupy 44.5 ha of the reclaimed land area) has changed; however, the level of risk remains the same as the Basis of Design/criteria, for such safety studies will not change.
- Changes to reduce GHG emissions, such as removing the furnace as heating medium, and instead using an electrical heater.
- A solar plant is planned to be constructed in a different plot as an offset solution for the Project, as it will compensate GHG emissions of the LNG plant. The solar plant will be assessed in a separate ESIA however it is considered as an associated facility in the scope of the Project.

1.8 Report Structure

This report is structured as follows:

- Section 2 – Regulatory and Administrative Framework: this section provides an overview of the national, international and corporate requirements that are applicable to the project.
- Section 3 – Project Description: provides a description of the main characteristics of the Project, including its updates since 2021 when the Project was put on hold with details on expected use of resources, emissions, and key project phases and activities. It also provides an analysis of the project alternatives considered;

- Section 4 – Terrestrial Environmental Baseline: this section outlines the baseline terrestrial (onshore) environment relevant to the Project, and highlights key sensitive aspects based on the results of field and desktop investigations;
- Section 5 – Marine Environmental Baseline; this section outlines the baseline marine (offshore) environment relevant to the Project, and highlights key sensitive aspects based on the results of field and desktop investigations. It also includes a habitats classification within the Project Area, performed according to International Finance Corporation (IFC) Performance Standard 6 (PS6);
- Section 6 – Social, Health, Cultural and Human Rights Baseline; this section outlines the social and cultural baseline relevant to the Project, and highlights key sensitive aspects based on the results of field and desktop investigations;
- Section 7 - Stakeholder Engagement; this section outlines the stakeholder engagement activities performed and planned to be undertaken along the project phases;
- Section 8 – Environmental and Social Impact Assessment; this section presents the assessment of the impacts that may result from the Project activities and the mitigation measures and management actions proposed be implemented to avoid, reduce, remedy or compensate for significant adverse effects and, where practicable, to maximise potential positive benefits and opportunities from the Project.
- Section 9 – Framework Environmental and Social Management Plan; this section presents the environmental and social management plan framework.
- Appendix A – Project Applicable National Legislative Framework; this appendix presents specific legal standards that will be applied to the project in terms of emissions, effluents and waste management.
- Appendix B – Stakeholder Engagement Plan (SEP)
- Appendix C – 2023 Air Quality Modelling
- Appendix D – Climate Change Risk Assessment (CCRA)
- Appendix E – Responses to SIPC Comments to the 2020 Scoping Report
- Appendix F – Responses to SIPC Comments to the 2021 ESIA Report
- Appendix G – 2023 BAT Assessment Report

2 REGULATORY AND ADMINISTRATIVE FRAMEWORK

This section provides:

- An overview of Oman's national vision and priorities in conjunction with Oman's political and administrative framework,
- ESIA regulatory framework, and national legal framework including:
  - Additional requirements for the Sohar Port Industrial Area (SIPC Policies and Guidelines, SEVESO III);
  - International Lender's Environmental & Social Requirements (International Finance Corporation & Equator Principles); and
- MARSA LNG LLC Corporate Standards.

2.1 Oman Vision 2040

Oman Vision 2040 launched in December 2020 provides national targets (Figure 2-1) and priorities (Figure 2-2) that shape the country's regulatory and administrative framework. It also provides the goals for shaping of roles and relationships between the public, private, and civil sectors to ensure: effective economic management; a diversified and sustainable national economy; fair distribution of development gains among governorates; and protection of the nation's natural resources and unique environment.

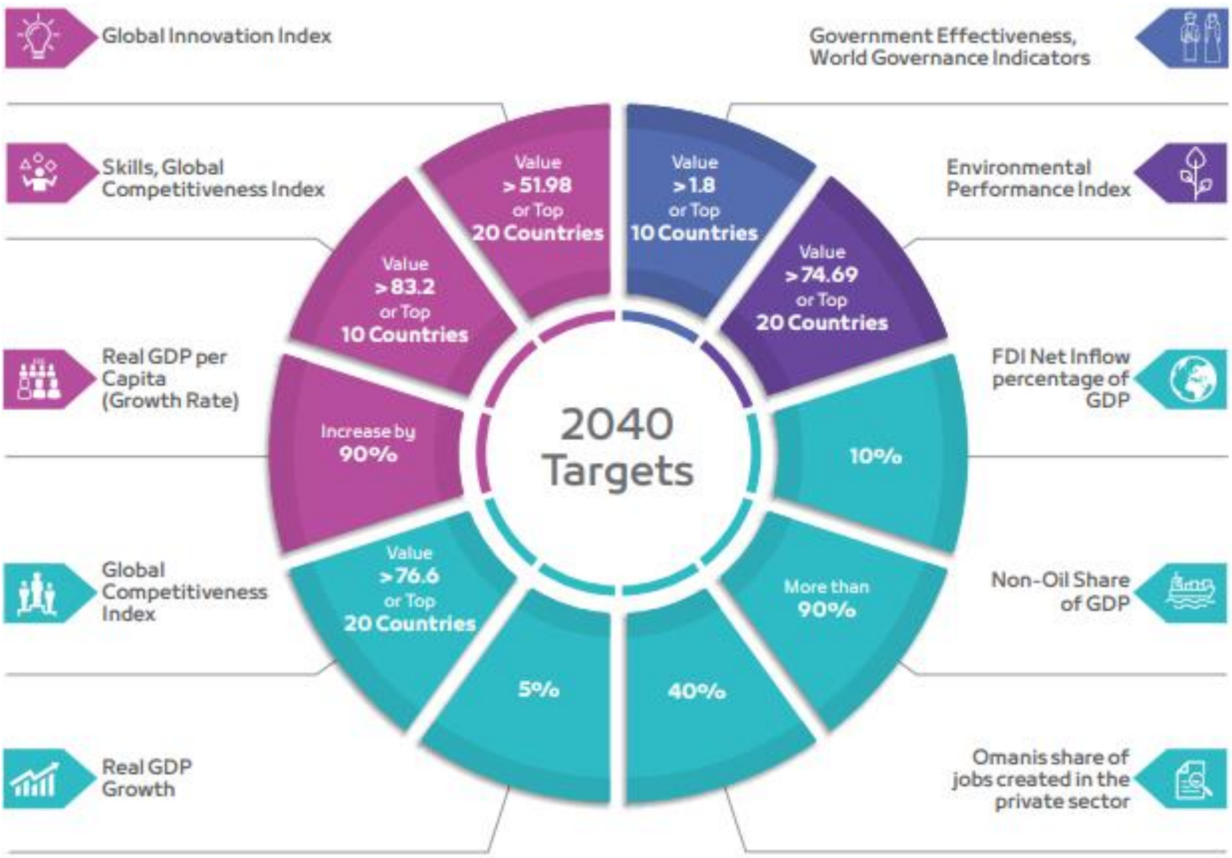


Figure 2-1 Oman Vision 2040 targets (Oman Vision 2040, 2020)

Figure 2-2 Oman National Priorities (Oman Vision 2040, 2020)

2.2 Second Nationally Determined Contribution (2021)

The Government Carbon Control Target Plan, aligned with Oman Vision 2040 and the National Energy Strategy, aims to facilitate a gradual shift towards a low carbon economy and a significantly reduced carbon emissions energy matrix by 2030. The plan focuses on the extensive adoption of renewable energy and implementing energy efficiency measures as the core pillars to achieve carbon control goals in the country. Oman has engaged through its NDC to reduce its absolute GHG emission by 2% by the year 2030.

2.3 Oman National Strategy for an Orderly Transition to Net Zero (2022)

The strategy aims to achieve carbon neutrality by 2050 and reduce the overall carbon budget. The strategy involves a gradual approach, prioritizing cost-effective decarbonization measures and employing six main technologies to address around 90% of emissions reduction. The remaining gap will be bridged through breakthroughs, natural negative emissions, and behavioural changes. Successful implementation requires technological maturity, new infrastructure, supportive policies, and market mechanisms. To ensure success, Oman must balance long-term planning with near-term actions and integrate key strategies across various sectors. The Oman Sustainability Center established through RD 30/2015 will be responsible for governance, progress tracking, stakeholder engagement, and investment planning. The strategy emphasizes aligning policies, legislation, and regulations at different levels to translate national targets into actionable policies and close any regulatory gaps.

2.4 Political and Administrative Framework

There are three levels of Government within the Sultanate of Oman: Central, Regional (or Governorate) and Wilayat. Details of the three levels are provided in section 6.3 of the ESIA.

2.4.1 Central Government

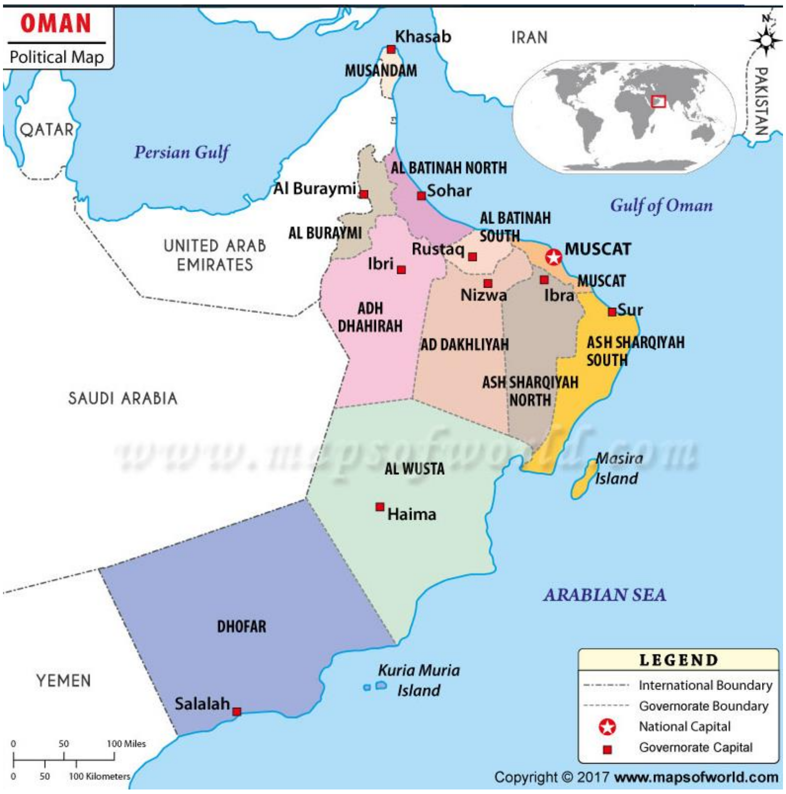
His Majesty Sultan Haitham bin Tariq Al 'Sa'id is the Head of State and the Head of Government. His Majesty appoints a Cabinet of Ministers. He presides over the Council of Oman (Majlis Oman), which comprises the Council of State (Majlis ad Dawla), and the Consultative Assembly (Majlis Al Shura).

The Consultative Assembly has 83 elected members (Shura Members) drawn from Oman's 61 wilayats. The Assembly serves as a conduit of information between the people and the government ministries. It is empowered to review drafts of economic and social legislation prepared by service ministries, and to provide recommendations. It has no authority in foreign affairs, defence, security, and finances.

National legislation is proposed and drafted through the Government Ministries based in Muscat. All legislation is reviewed and affirmed by the Council of State and the Consultative Assembly and in turn implemented through the actions of the Regions through regional offices, which may be present in larger Wilayat Centres to represent the various Ministries.

2.4.2 Regions and Governorates

Oman is divided into 11 Governorates, which are divided into 61 provinces or wilayats (as shown in Figure 2-3). The Project is located in the Al Batinah North Governorate.



Source: Mapsofworld (https://www.mapsofworld.com/oman/map.html)

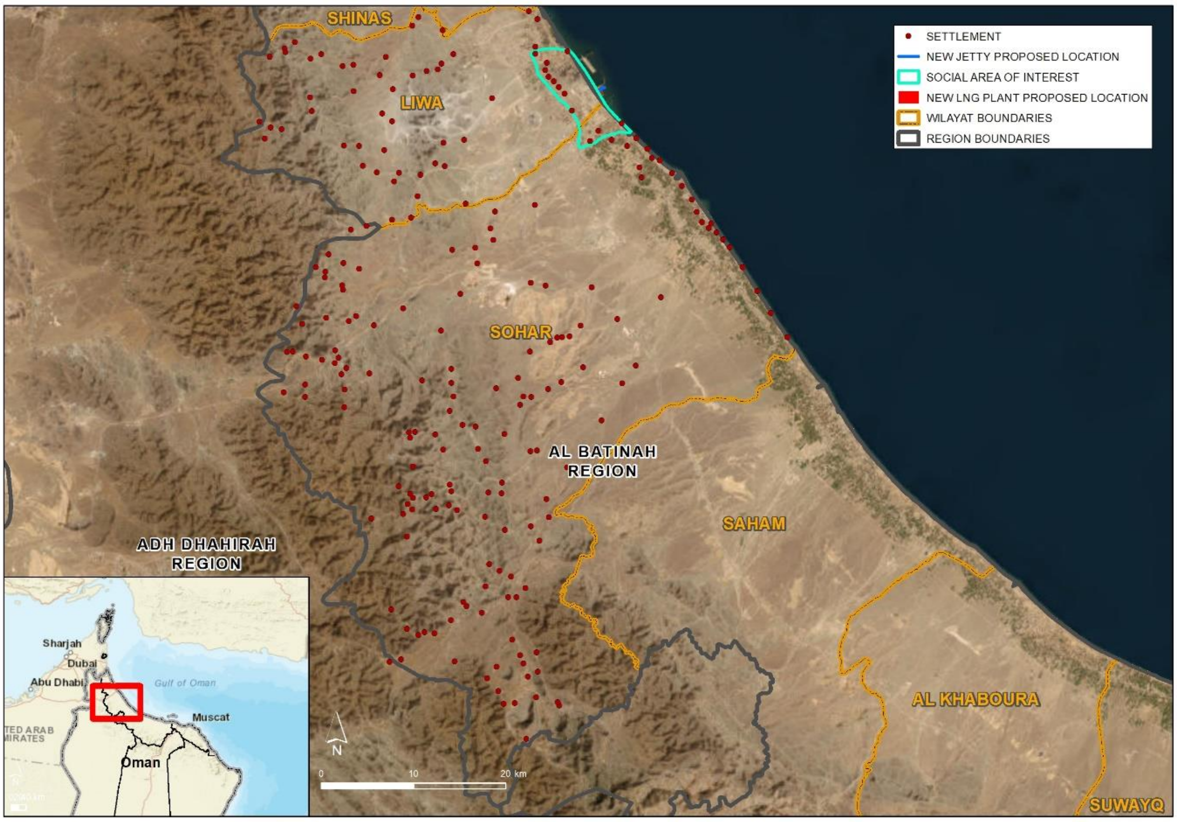
Figure 2-3 Overview of the Sultanate's Governorates

Over the past 50 years, there has been a rapid growth of regional wealth and concomitant economic development as a result of significant revenues from oil and gas production for Gulf Cooperative Council (GCC) countries. The small populations of GCC countries have led to a strong demand for expat labour into the region during this period of rapid economic growth. In Oman, a relatively high national population growth rate and sustained immigration rates of expat labour have caused rapid population growth, urban development and relatively intense economic development, much of which is concentrated in coastal areas.

2.4.3 Wilayat

Each Governorate is made up of wilayat or provinces (sing. wilayah) usually based around a town or large village. Al Batinah North Governorate consists of six wilayats: Sohar, Shinas, Liwa, Saham, Al Khaburah and As Suwayq. The Project area spans two wilayats: Liwa (to the north) and Sohar (to the South). Each Wilayat is led by a Wali and contains a number of settlements that are represented by sheikhs, who regularly engage directly with the Wali. The main government interface for sheikhs is therefore the Wali, the respective roles and responsibilities of which are described below.

Figure 2-4 below shows the location of the Project site along with the administrative boundaries of the Wilayat of North Al Batinah Governorate. The settlements in the Wilayat of Sohar and Liwa are marked with red dots.



Source: ERM, 2023.

Figure 2-4 Wilayat of Liwa and Sohar in North Al Batinah Governorate

2.5 National Legal Framework

Environmental protection within Oman is primarily governed by the "*Law for the Conservation of the Environment and the Prevention of Pollution*" (Royal Decree, RD, 114/2001) administered by the

Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA).

For reference, relevant environmental laws are summarised in relation to Project requirements. It includes Royal Decrees (RDs) and Ministerial Decisions (MDs) relevant to the ESIA permitting process and to environmental compliance. Table 2-2 lists the international agreements and conventions acceded to and in most instances ratified by Royal Decree, which the Project should uphold through the implementation of the requirements of the legislation listed in Table 2-1, and Good International Industry Practice (GIIP).

Further information relating to key RDs and MDs is provided in Appendix A in conjunction with a non-exhaustive list of legislated limits for environmental aspects (e.g. air quality and noise).

Table 2-1 Environmental laws and their relevance to the Project.

RD/ MD No.	Legislation Aim	Summarised relevance to Project
Specific to the Oil and Gas Industry		
RD 8/2011	The Oil and Gas Law: Environmental protection.	■ Take all necessary measures to protect the environment. ■ Achieve compliance with all legislation that relates to environmental protection. ■ Apply project offsets and buffer zones (Article 26 and 27). ■ Social welfare requirements regarding national manpower, training programmes, workforce protection. ■ Environmental and social requirements with strict penalties in the event of non-compliance; ■ Execute operations with due diligence according to Oman technical standards and Oman international agreements.
Principles of Environmental Management		
RD 114/2001	Conservation of the environment and prevention of pollution.	■ Conserve resources ■ Avoid pollution ■ Implement environmental management procedures as well as immediate measures to rectify faults (including from emergencies) ■ Apply BATNEEC ■ Develop a contingency plan for periodically review ■ Comply with requirements of Ministerial Decisions issued subsequent to Royal Decree 114/2001.
Environmental Approvals and Regulation		
MD 48/2017 RD 114/2001 AD 107/2023	Regulation of the issuing of Environmental Permits/Licences, including fees and fines.	■ Project proponent to obtain an environmental permit prior to commencing project activities ■ An environmental permit will be issued for a max period of 3 years, renewable in the 34th month for another period of 3 years. ■ Issuance and renewal of environmental permits for a Category A project is OMR 900 per activity relevant to the project. ■ EA and SIPC must be notified, prior to commissioning, that environmental requirements for operation are fulfilled and of the proposed commencement of Operation date ■ Spills must be reported immediately to the EA and specify the circumstances, type, and quantity of the spillage as well as measures to stop or control the spillage.
MD 209/1995	Fulfilment of environmental permit condition and penalisation of violators.	■ Ensure compliance with the conditions of environmental permits. ■ Permit violations may result in fines and complete stoppage of Project activity until violation is resolved.
Nature Conservation		
RD 114/2001 RD 6/2003 RD 8/2003 RD 67/2002 MD 110/2007	Protection of ecology and biodiversity	■ Do not damage trees. ■ Avoid damaging shrubs where possible. ■ Do not kill animals. ■ Do not introduce non-native species
MD 169/2000 MD 128/1993 MD 5/2017	Protection of vegetation, in particular the cutting and felling of trees, notably *Prosopis cineraria* (Ghaf)	

RD/ MD No.	Legislation Aim	Summarised relevance to Project
MD 101/2002	Banning the killing or hunting of wild animals and birds	
MD 3/2021	Prohibition of possessing and using tools and devices for hunting, tracking, and imitating the sounds of wild birds and animals	■ Affects the use of bird deterrents for managing bird pest species or minimising biodiversity impacts (very low relevance to the project)
Atmospheric Emissions		
MD 118/2004	Relating to atmospheric emissions from stationary sources	■ Ensure that atmospheric emissions are compliant with MD 118/2004. ■ Monitor emissions from stationary sources on a scheduled basis.
MD 18/2012 MD 20/2016	Regulations for the Management of Climate Affairs	■ A permit (valid for 2 years) may be required relating to the emission of greenhouse gases for emissions above 2,000 tpa CO_2e. ■ Issuance and renewal of environmental permits for a Category 1 Projects (listed in MD 18/2012 Annex 2) activity is OMR 100. ■ GHG emissions to be recorded and reported to EA. ■ Landscaping plan to promote carbon sequestration to be submitted to EA. ■ Low energy consuming and renewable energy technologies to be included in the project design.
MD 41/2017	Ambient Air Quality Standards	■ Carry out ambient air quality monitoring as per the requirements of EA.
MD 107/2013	No use of substances that deplete the ozone layer	■ Ensure that the project does not use any substances that are banned or being phased out in accordance with the Montreal Protocol.
MD 37/2001	Prohibition of Ozone depleting substances (ODS)	■ Issuing the Regulation on Control and Management of ODS.
MD 243/2005	Prohibition of Ozone depleting substances (ODS)	■ Regulation for the Control and Management of ODS.
MD 107/2018	Relating to Energy Labelling and Energy Performance Requirements	■ Ensure that air conditioning equipment brought to site complies with GCC Standard GSO 2530/2016 and is registered according to the Omani Energy Efficiency Ratio System.
Noise		
MD 79/1994 MD 80/1994	Relating to noise emissions in the public and working environments	■ Ensure that noise levels beyond a project perimeter fence are <70dB. ■ Issue PPE as and where necessary.
Climate Affairs		
MD 20/2016	Minimise impact on climate change	Regulations for the Management of Climate Affairs: ■ Obtain relevant licenses to emit greenhouse gases. ■ Collection and reporting of greenhouse gas emissions. ■ Use of Best available technologies to reduce greenhouse gas emissions.

RD/ MD No.	Legislation Aim	Summarised relevance to Project
MD 117-2013 Guideline/Form 1	Guidelines for the Preparation of Climate Affairs Chapter in the Environmental Impact Assessment Study for the Projects (2017)	■ Provides definitions and procedures for submitting a Project inventory of Greenhouse Gas (GHG).
Waste		
MD 77/1988	Relating to Public Health	■ Dispose of wastes to a Municipality approved waste site.
MD 17/1993	Relating to non-hazardous wastes	■ Do not mix non-hazardous with hazardous waste. ■ Implement a consignment note system.
MD 18/1993 MD 10/2017	Relating to hazardous wastes	■ Segregate wastes by type. ■ Dispose to a registered hazardous waste site or management company. ■ Use licensed waste transporters only.
Wastewater		
RD 115/2001 MD 145/1993 MD 12/2017 MD 421/1998	Relating to wastewater management and discharge	■ Dispose of sewage to a Municipality approved sewage treatment plant. ■ Ensure treated effluent complies with required standard. ■ Ensure septic tank and soakaway designs are compliant with design specifications.
MD 55/2002	Amending MD 145/1993	■ Obtain a permit for the re-use and discharge of produced water.
Water use		
RD 29/2000 RD 115/2001 MD 192/2001 MD 195/2001 MD 243/1997 MD 264/2000	Relating to the protection of water resources and use of water supply wells	■ Obtain water from an approved source. ■ Ensure that activities do not threaten the integrity of water resources. ■ Obtain relevant permissions prior to constructing a water supply well.
Soils and Topography		
MD 200/2000	Relating to quarries and borrow pits	■ Obtain approval from the local Municipality to excavate borrow pits.
Heritage and Culture		
RD 35/2019	The Law on Cultural Heritage	■ Ensure archaeological & cultural heritage sites are not affected by project activities. ■ Report archaeological and heritage finds and sites to the Ministry of Heritage and Culture (MHC). ■ Obtain permission from the MHC before commencing project activities in areas where sites of archaeology and/or cultural heritage are known to be present.
RD 37/2019	Preservation of Geological Heritage	■ Not known precisely at this time. The issue of the RD should indicate that that prior to conducting earthworks in certain areas that it may be necessary to seek permission from MHC.
Chemicals and Radioactive Materials		
RD 46/1995 MD 248/1997 Amendments: MD 317/2001 MD 25/2009 MD 79/2006 MD 14/2017	Relating to the import, distribution, use and disposal, permitting requirements, and storage of chemicals	■ Ensure that MARSA LNG and its contractors have relevant permits in place for procurement and use of materials during both construction and operational phases and ensure that the correct facilities are available for their safe storage and management.

RD/ MD No.	Legislation Aim	Summarised relevance to Project
MD 281 /2003 MD 50/2023		■ Ensure that the project does not use any banned materials and substances.
Authority Decision 79/2023	Issuing the Regulation for Radiation Protection and Safety and Security of Radiation and Radioactive Material	■ The entry to the Sultanate of radioactive materials, or equipment that contains them shall only be by air and it is prohibited transport them within the country except by land transportation; ■ Permit to be obtained for the handling and use of radioactive materials; ■ All radioactive sources should be returned to the manufacturer for disposal
MD316/2001	Control of hazardous chemical materials.	■ Ban the use and circulation of some hazardous chemical materials, including pcbs, brown asbestos, and blue asbestos.
Socio-economics / Health and Safety		
MD 25/2013	Relocation of people in Liwa and the seizure of real estate and land for the public benefit.	■ People affected by the Sohar Industrial Port will be relocated through the Liwa Housing Project.
RD 35/2003 Amendments: RD 74/2006 RD 112/2006 RD 63/2009	Oman Labour law providing minimum standards and conditions of employment.	■ Minimum standards and conditions of employment.
MD 286 / 2008 Amendments: MD 322/2011	Occupational Health and Safety regulations and provisions for safe working practices and environments	■ Occupational Health and Safety regulation of Oman provides minimum working standards and conditions, including provision of personal protective equipment and seasonal working hours.
RD 6/2022	Personal Data Protection Law	■ Protection of data collected from staff regarding employment details, and social data collected through questionnaires.
RD 29/2001 RD 40/2014 RD 55/2019 Decision 9/2023	Executive Regulation of the Statistics and Information Law	■ Obtaining a statistical license from the National Centre for Statistics and Information (NCSI) prior to conducting any survey or poll (collecting feedback during the ESIA disclosure process).
Marine and Coastal Environment		
MD 20/1990	Regulation of Coastal Setbacks with regard to low impacted beaches, sandy beaches & khwars (lagoons), and scenic coasts.	■ Setback of 50m from beaches where the construction developments have limited impact on the environment. ■ Exception to setback must be approved by EA in coordination with the Ministry of Housing.
MD159/2005	Licensing framework and requirements for liquid waste discharge in the marine environment.	■ License is required to discharge any liquid effluents to the marine environment either directly or indirectly. License is based on volume and waste type discharged. ■ Liquid waste must be reused, recycled, or dangerous components of liquid waste must be removed before discharge.

Table 2-2 Legislation passed ratifying international agreements

Reference No.	Title
RD 119/1994 RD 28/2019	Basel Convention for Control of Transboundary Movement of Hazardous Wastes and their disposal United Nations Framework Convention on Climate Change provides greenhouse-gas-emissions mitigation, adaptation, and finance.
RD 67/2002	Agreement of the Conservation of Natural Life and its Natural Habitats in the Gulf Cooperation Council Countries
RD 64/2012	Ramsar convention on wetlands promotes conservation and wise use of all wetlands
RD 56/2005	Convention for the Safeguarding of Intangible Cultural Heritage
RD 77-96	Accession of the Sultanate to the Agreement on Implementing Section 11 of the UN Convention on the Law of the Sea, 1982. Part XI of the Convention provides for a regime relating to minerals on the seabed outside any state's territorial waters or EEZ (Exclusive Economic Zones).
RD 25-81	International Conventions and Multilateral Agreements
RD 39-208	Oil Preparedness, Response and Cooperation, 1990. Requires that all appropriate measures are taken to prepare for and respond to oil pollution incidents.
RD 55-2002	Cartagena Protocol on Biological Safety Related to Biodiversity Convention
RD 73/1998 Amendments: RD 106/2004 MD 37/2001	Montreal Protocol prohibiting the use of substances that Deplete the Ozone Layer.
RD 90/1991	Kuwait Regional Convention on Protection of Marine Environment from Pollution
RD 107/2004	Kyoto Protocol on Climate Change
RD 81/1999	Rotterdam Convention on Prior Informed Consent Practices for Certain Hazardous Chemicals
RD 117/2004	Stockholm Convention on Persistent Organic Pollutants (POPs)
RD 60/1984	International Conventions for Rules Preventing Collision at Sea and Safety of Life at Sea. Provides navigation rules for ships and vessels at sea to prevent collisions between two or more vessels.
RD 73/1998	Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer
RD 42/2005	Convention on the Elimination of all Forms of Discrimination against Women
RD 65/2005	Convention, 1957 (No. 105) on the Abolition of Forced Labor, and the Convention, 1973 (No. 138) on the Minimum Age for Admission to Employment

2.5.1 Oman Environmental Protection and Administration

2.5.1.1 Environmental Authority

The Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA) was established on the 18th of August 2020 by Royal Decree No. 106/2020. EA is responsible for issuing regulations, standards and guidelines for the implementation of environmental protection, control and management laws, as represented in Omani laws (e.g., Royal Decrees, RDs, and Ministerial Decisions, MDs). The Directorate General of Environmental Affairs (DGEA) within EA provides guidelines on how EIAs are to be conducted in Oman, and the Environmental Assessment and Permit Centre is mandated with the role of coordinating the ESIA process and issuing preliminary and final environmental permits.

In accordance with RD114/2001, EA is the main authority responsible for issuing Environmental Permits for developments within Oman (Article 9). EA has the authority to either reject applications or issue permits, as well as to set conditions for the permits related to the LNG Bunkering Project, according its potential impacts on the environment. Environmental legislation is in place to help define and guide this authority, in the form of Royal Decrees, Ministerial Decisions and international laws, protocols, agreements and conventions to which the Sultanate is signatory.

The authority preserves environmental integrity and the sustainability of developments through sound efficient environmental management in all sectors. Environmental inspections and programs for environmental control are exersised to monitor environmental conditions during and after projects are implemented, and impacts are minimised to the maximum extent possible. National laws, systems, regulations, decisions and strategic programs are upheld for the protection of the Omani environment and compliance with the Sultanate's commitments to international environmental agreements. The ministry follows up the implementation, preparation and updating of the national strategy for chemicals management and operates national networks to monitor environmental pollutants in conjunction with managing environmental violations.

2.5.1.2 Sohar Industrial Port Company (SIPC)

On November 18th 2018, EA and SIPC signed a Memorandum of Understanding which details a long-term strategic programme for the continuous enhancement of environmental management in the Sohar area. The programme focusses on environmental permitting, and compliance of all port operations with local legislation, international best practices, and continuous monitoring of the impact of operations to the environment.

As a result, SIPC has been designated with the responsibility of managing environmental related issues and overseeing permit applications within Sohar Port[6] relevant to the LNG Bunkering Project. SIPC is the lead concessionaire and will apply its corporate policies (Rules and Regulations) to the design, permitting, construction, and operation of the Project. SIPC corporate policies and procedures that will provide direction to the design, permitting, construction and operation of the Project, are described in Section 0.

Among SIPC responsibilities is the review of supporting documents, such as Environmental Impact Assessments (EIAs), and other studies required by the Port.

Once approved by SIPC, the recommendation for approval is submitted to EA who then issues the relevant permit. EA is the national regulator and has the ultimate power to accept or reject permit applications. In order to prevent potential conflicts between SIPC and EA in terms of Project approval, a 'No Objection[7]' is typically given at the concept stage of a project after SIPC consults with the relevant ministries on the appropriate level[8]. Hence, whilst it would be considered a remote possibility (and therefore risk) for a project that is approved by SIPC to then be rejected by EA, it is considered prudent to consider this within any risk assessment for the Project reassuring that all the permitting steps are duly agreed and formalized, as well as a constant dialogue is maintained with EA.

Roles and responsibilities of the authorities involved in the environmental permitting of the Project are outlined in Table 2-3.

[6] The SOHAR Port and Freezone is operational since 2002 and is being managed by Sohar Industrial Port Company (SIPC), a 50/50 joint-venture between the Port of Rotterdam Authority and the Omani government.

[7] No Objection is typically given when the proposed activity fits in the concept of spatial planning or industrial estate and the foreseen environmental impacts are not long term, on a large scale or affect the community. For large scale industrial activities or activities with an exceptional risk profile, a No Objection is given after consulting the relevant ministries on the appropriate level.

[8] Guidance Note: Requirements for EIA, ER, IPPC and Seveso II (REP-147-11-DJ Guidance Note EIA IPPC); January 2011.

Table 2-3 Roles and responsibilities of the authorities involved in the environmental permitting of Project

Authority	Role during the environmental permitting
Central Authorities	
Environmental Authority / Environmental Assessment and Permit Centre	Competent Authority responsible for issuing the environmental permits after the review and approval of the EIA by SIPC
Sohar Industrial Port Company / Environmental Department	Consultation with the project owner and local environmental consultant throughout the scoping and EIA process
	Review of permit applications, Environmental Impact Assessments and other relevant supporting documents
	Submission of approved EIA supporting documents to EA

2.6 ESIA Regulatory Framework

2.6.1 ESIA in the Context of Regulatory Permitting

The requirement for EIAs in Oman is described in Article 16 of RD 114/2001 (Law on Conservation of the Environment and Prevention of Pollution), which states:

"The owner of any source or area of work which – according to the basis specified by the Ministry – may constitute an avoidable or curable risk to the environment, shall submit, prior to the application for the environmental permit, a detailed EIA study confirming that the benefits of the source or area of work surpass the potential damage to the environment."

Based on the Guidelines for Obtaining Environmental Permits, published by EA (RD 187/2001) and Ministerial Decision 48/2017 on Regulations for Organising Environmental Permitting, the Project can be classified as "Category A" and requires an EIA due to the likely activities listed in Table 2-4.

Table 2-4 Anticipated activities requiring an EIA under Ministerial Decision No. 48/2017

Category A: Activity	No.	Ref.
Manufacture of industrial gases, elemental gases, liquid or compressed air, refrigerant gases, mixed industrial gases, inert gases such as carbon dioxide and isolating gases	201102	18
Manufacture of liquefied or compressed gases	201108	23
Transport of gases, liquids via pipelines (not including water network)	493001	137
Manufacture of refinery gases such as ethane, propane, butane etc.	192003	9

2.6.2 ESIA in the Context of Project Financing

International financing may be required in order for the Project to proceed. As such, the Project will need to comply with the IFC Performance Standards and IFC Environmental, Health and Safety Guidelines. This will be via the impact assessment and mitigation developed in the ESIA, and additional documents supporting the implementation of mitigation and management measures, such as the Environmental and Social Management Plan (ESMP) and individual supporting management plans for specific topics which will be implemented within the framework of a robust Environmental and Social Management System (ESMS).

At this stage, for the purposes of defining international lender requirements it has been assumed that compliance with the International Finance Corporation (IFC) Performance Standards for Environmental and Social Sustainability and the Equator Principles adopted by the majority of the world's major project finance banks will be an appropriate benchmark. Consideration of additional specific requirements of other lenders will be taken into account as necessary when the composition of the lender consortium is confirmed.

2.6.3 ESIA Process and Approval

EA is responsible for issuing regulations, standards and guidelines for the implementation of environmental protection, control and management laws, as represented in Omani laws (e.g. Royal Decrees, Ministerial Decisions).

Oman Ministerial Decision (MD) No. 48/ 2017 outlines the environmental permitting process (Table 2-5) and stipulates that the Project is classified as a category A; i.e. Manufacture of liquefied or compressed gasses and "transport of gases, liquids via pipelines (not including water network) which requires an EIA.

Project activities will be identified by EA and included in the Project's commercial registration through the online Invest Easy Portal. This ESIA Report is therefore submitted to SIPC and EA for approval in order to allow the Project to commence.

Table 2-5 Permitting Process Summary (Ministerial Decision No. 48/2017)

Article	Summarised Description
1	Definitions pursuant to MD 48/2017.
2	Activities must be classified into categories (A, B, or C).
3	Owner to apply to EA for an environmental permit according to a project's category (A, B, or C).
4	EA will determine the safe area[9] and the activities to be practiced therein.
5	The owner, when applying for an environmental permit, shall coordinate with EA to designate a safe area surrounding the proposed site of the project in accordance with the decision of the Ministry in this regard. The proposed site of the establishment, if necessary, shall be inspected by officials from the Ministry prior to issuance of environmental permit. EA may require a risk assessment or other specialised study (if necessary). These studies must be prepared by an approved environmental consultancy office (in accordance with rules and disciplines laid down by EA in this regard).
6	The competent authority in the Ministry shall grant an environmental permit to the owner of the project after ensuring that all requirements are met for issuance of the environmental permit as well as reviewing the required documents set out in Article 3 and Article 5 (above) of the Regulations. If an environmental permit has been granted, fees against each source in an area of work shall be collected separately.
7	After granting the environmental permit, EA may require the owner to conduct an Environmental Audit regarding areas of work or any other specialised studies (where necessary).
8	Not applicable as relates specifically to mining activities.
9	Once the project is completed, the owner shall notify EA in writing (30 days prior to commencing commissioning and operation) that environmental requirements for operation are fulfilled. Notification must include the date of operational commencement.
10	The environmental permit shall be valid for three years and renewable for a similar period.
11	Owner shall apply to EA for permit renewal not more than 60 days before its expiry. Category A projects will incur a fine of OMR 150 if the permit is 30 days past its expiry date (in addition to a renewal fee).
12	Category A fees for issuance and renewal of an environmental permit is OMR 1500.
13	Violation of MD 48/2017 is punishable through fines.

[9] The area separating the source or area of work from ecosystem or heritage area or natural resource, which requires a special protection.

A summary of the Omani EIA approval process is presented in Figure 2-5, in conjunction with IFC PS led processes (i.e. social data gathering during the scoping phase, and the Project disclosure and public consultation meeting during the ESIA process, to disclose the results of the ESIA).

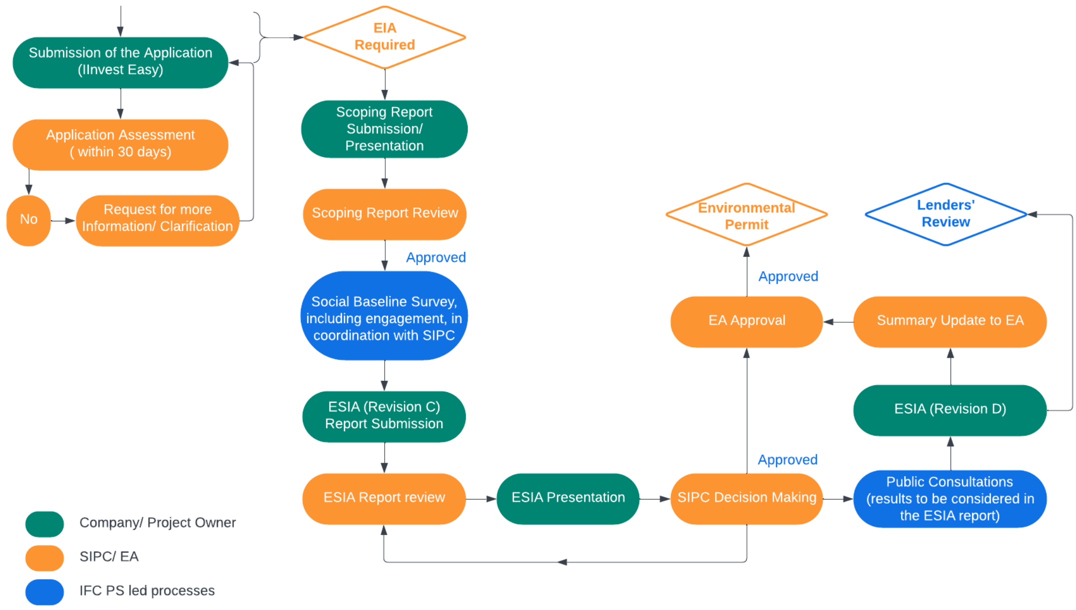


Figure 2-5 EIA Approval Process in Oman, including IFC PS led processes required by international lenders

2.7 Sohar Port Industrial Area Requirements

2.7.1 Best Available Techniques

In terms of referring to operations, it is acknowledged that future tenants will be expected to embrace Best Available Techniques (BAT) in the design of their plant (e.g. process technology). Oman operates a permitting system for industrial activities that reflects the approach in the system of Integrated Pollution Prevention and Control (IPPC). The ultimate aim of these concepts is to minimise pollution.

Best available techniques (BAT) are those best for preventing or minimizing emissions and impacts on the environment. BAT is often specified for operations and activities in an industrial installation. This is the case for Oman, which is a member of the Organisation for Economic Co-operation and Development (OECD), which advocates the characterization and use of established methodologies to establish BAT in development projects. The European Commission (EC, in the EU) Integrated Pollution Prevention and Control (IPPC) is a regulatory system that adopts an integrated approach to control the environmental impacts of certain industrial activities, particularly in industry. The EU has adopted (1996) a set of common rules for permitting and controlling industrial installations in the IPPC Directive (directive 96/61/EC), codified in Directive 2008/1/EC and then included in the Industrial Emission Directive (IED) 2010/75/EU. Industries will be encouraged to embrace the principles of IPPC, which embody minimising pollution, and underlie the permitting system in Oman.

According to the Industrial Emission Directive (IED), the Natural Gas Liquefaction Plants would fall under its application as:

- Annex I Category 1.4: Gasification or liquefaction of: (b) other fuels in installations with a total rated thermal input of 20 MW or more.

The current Project will include the heating medium as electrical heaters; therefore, the Heating Medium is not subject to emission limits. In addition, incinerator and flares are abatement/emergency system and not directly associated with the production. This equipment is not expected to exceed the 20 MWth threshold that triggers the application of the IED directives. Therefore, it is understood that the LNG Bunkering Project does not fall under the application of the IPPC and application of the relevant Best Available Techniques is not required. However, as the EU BAT concept is widely considered the most effective in terms of environmental protection and cost effectiveness, MARSA LNG LLC has decided to apply them for this Project as Best Practice.

In particular, the Plant will comply with the *EU COMMISSION IMPLEMENTING DECISION of 9 October 2014 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the refining of mineral oil and gas*, also known as the “Refinery” BAT.

A BAT assessment has been developed in order to evaluate the Plants compliance with the “Refinery” BAT aforementioned. The BAT assessment is presented in Appendix G.

2.7.2 Industrial Safety

There is no legal framework available for industrial safety in Oman. For this reason, principles governing the industrial safety shall be established in line with the booklet Rules and Regulations of the SOHAR Port and Freezone Area (latest ones from 2021). Additionally, guidelines to these Rules and Regulations are published separately on the SOHAR Port and Freezone (SPF) website and do form an integral part of these rules and regulations.

Basically, with respect to the control of major accident hazards SOHAR Port and Freezone follows the E.U. Seveso Directive principles.

2.7.2.1 Safety Obligations

According to SPF Rules and Regulations, Tenants whose activities pose an external risk of major credible accidents (such as referred to in Seveso III or UK COMAH criteria) shall:

- Make a Quantitative Risk Assessment;
- Implement a Safety Management System;
- Prepare a Safety Report.

2.7.2.1.1 Quantitative Risk Assessment

A Quantitative Risk Assessment (QRA) is a systematic identification of possible hazards, quantified as to its likelihood and consequences and spatially represented as risk contours around the concerned source of possible hazard.

The above-mentioned quantitative risk assessment is an integral part of the HSSE Framework and through this must be made available to SPFA and must be updated after significant changes of the hazard risks. The QRA shall be made with industry standardized quantitative risk analysis software (Phast, Safeti or comparable).

Three separate QRA -one per FEED tenderer- have been completed as part of FEED activities and are available to SPF.

2.7.2.1.2 Safety Management System (SMS)

Based on the QRA, the Tenant shall establish a Safety Management System documenting his major-accident prevention policy. A Safety Management System comprises of all measures necessary to prevent major accidents and to limit their consequences for human safety and the environment. If there are changes made in the operation or facilities of the Tenant that might have impact on hazard risks, the Tenant will make sure that the major-accident prevention policy and Safety Management System is reevaluated and amended accordingly.

2.7.2.1.3 Safety Report

From the total maximum amounts and properties of Seveso dangerous substances on site, the MARSA LNG Plant is classified as an Upper Tier establishment. The major contributors to this figure are the liquefied natural gas, classified for the purpose of the Seveso regulations as “extremely flammable gas” together with diesel, propane, pentane and ethylene all named substances in the Seveso regulations.

In order to demonstrate that all that is necessary has been done to prevent major accidents, and to prepare emergency plans and response measures, the operator shall provide SOHAR Port and Freezone with information in the form of a Safety Report.
In the Safety Report it should be established that:

- a major-accident prevention policy and a safety management system has been introduced;
- major-accident hazards are identified, and the necessary measures have been taken to prevent such accidents and the consequences for man and the environment;
- the design, construction, operation and maintenance of all installations associated with the operation of the plant, warehouses, equipment and infrastructure associated with the dangers of a major accident within the facility are sufficiently safe and reliable;
- a Tenant Emergency Response Plan was created.

According to the Seveso Directive, the Safety Report should be submitted to the competent authorities in reasonable period of time prior to the start of construction or operation. A Safety Report (document reference OM-SOH-00-TOTA-000118) has therefore been prepared for the plant at the end of the FEED phase.

This report focuses on the design of the MARSA LNG Plant, but also describes the principles governing the operational emergency response measures to major accidents and the HSE Management System as well. The report encompasses the three designs developed by the three tenderers during the FEED competition.

The structure of the Safety Report is as follows:

- Section 1 contains the definitions and abbreviations;
- Section 2 contains this summary and section guide to the report;
- Section 3 describes the plant, the hazardous substances on site, and the processes performed;
- Section 4 describes the identification and the evaluation of Major Accidents;
- Section 5 describes the overall risk assessment process and their results;
- Section 6 describes the physical plant safeguards protecting against potential hazards;
- Section 7 describes the emergency response measures protecting against potential hazards;
- Section 8 describes the HSE Management System;
- Section 9 presents the conclusions and recommendations.

The Safety Report shall be reissued during the detail engineering (EPSCC phase) in line with findings from the updated QRA.

2.7.2.1.4 Provision of Information

In order to reduce the risk of a major accident affecting other parties' operations or the public, every Tenant whose activities pose an external risk of major credible accidents shall proactively provide appropriate information about their hazard risks incl. fire, explosion and toxic cloud incident scenarios to SPFA, neighboring parties and relevant public authorities.

2.7.3 SIPC Policies

The Sohar Industrial Port Company (SIPC) is the lead concessionaire and will apply its corporate policies (Rules and Regulations 2021) to the design, permitting, construction, and operation of the Project. The SIPC (through its Health, Safety and Environment Policy) is committed to creating and maintaining a healthy, safe, secure, and environmentally friendly space for the industries, its employees, visitors and the surrounding population and nature. SIPC corporate policies and procedures (that will provide direction to the design, permitting, construction and operation of the Project) are outlined below.

2.7.3.1 Safety

Principle standards for regulation of safety in the Sohar Port and Freezone include the Royal Oman Policy Directive of Civil Defence rules and regulations; and principles of Seveso III and UK COMAH, describing procedures for Quantitative Risk Assessment and design of a Contingency Plan.

2.7.3.2 Road Safety

Sohar Port and Freezone road safety standard requires that all drivers, vehicles and equipment shall comply with the road traffic laws of Oman and Royal Oman Police (ROP) traffic rules and regulations.

2.7.3.3 Labour Camps

Only existing labour camps, located outside the port, will be used for construction activities.

2.7.3.4 Dangerous Goods

Dangerous goods and substances are regulated through:

- IMO- IMDG-Code Royal Decree No. 46/1995, Handling and use of chemicals;
- MD 248/97, Registration of Hazardous Chemical Substances and the relevant permits;
- MD 249/97, Control and management of Radioactive Materials; and
- MD 317/2001, Packing and labelling of hazardous chemicals.

All Vessels are obligated to report Dangerous Goods to the Harbour Master Office SIPC by Vessel Notification System. Dangerous installations/substances must be outlined in Contingency Plans of Sohar Port and Freezone tenants.

2.7.3.5 Construction Activities

For construction activities in the Sohar Port and Freezone, a framework Work Permit relating to common areas and an HSE-Plan must be submitted to SIPC. The permit and plan must comply with good international practices with regard to identification of hazards, containment measures, and monitoring systems.

2.8 International Lender's E&S Requirements

The international lenders' environmental and social requirements are a condition of finance and have direct implications for the Project. Environmental and safety requirements of international lenders are discussed in this section with regard to IFC performance standards, general and specific industry standards, as well as Equator principals.

2.8.1 IFC Performance Standards

Given the potential involvement of international financing, the Project documentation will need to align with the 2012 IFC Performance Standards (PS) and IFC Environmental, Health and Safety (EHS) Guidelines (Figure 2-5). The IFC Performance Standards provide a framework through which to manage environmental and social risks and impacts of a project.

There are eight Performance Standards (Figure 2-6), which cover a range of environmental and social topics.

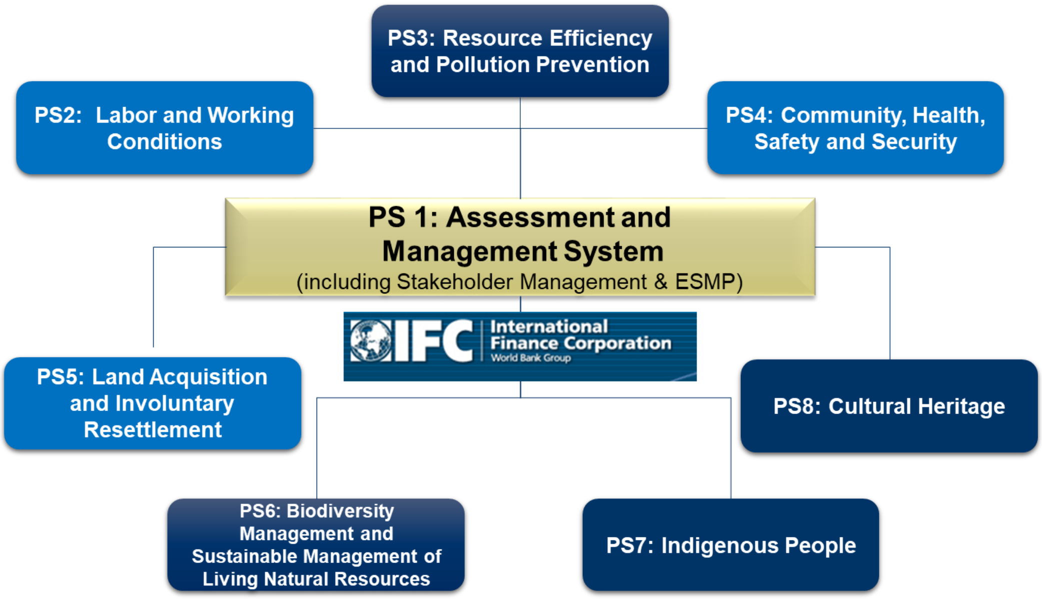


Figure 2-6 IFC PS Framework

Implementation of the Performance Standards should lead to a project that: promotes sound and sustainable social and environmental performance and looks to constantly improve performance in this area; demonstrates improved financial, environmental and social outcomes; identifies and assesses its environmental and social impacts; avoids, minimises and mitigates impacts wherever possible; and ensures that affected communities and local stakeholders are appropriately engaged.

A summary of the eight Performance Standards is included in the Table 2-6 below. Performance Standard 5, 7 and 8 are not relevant to the Project as no land is being acquired/ restricted, no involuntary settlement is taking place, no indigenous people are affected by the Project and as no archaeological remains are expected to be encountered since the Project site is built on reclaimed land sourced from dredging material and will use existing access roads and local borrow pits.

Table 2-6 Summary of the Project relevant IFC Performance Standards

IFC Performance Standard		Description
1	Environmental and social risk and impact assessment	Underscores the importance of managing environmental and social performance throughout the life of a project (any business activity that is subject to assessment and management).
2	Work and working conditions	Recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by the protection of the fundamental rights of workers.
3	Efficiency of the use of resources and pollution prevention	Recognises that increased economic activity and urbanisation often generate increased levels of pollution to air, water, and land and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels.
4	Health and safety of the community	Recognises that project activities, equipment, and infrastructure can increase community exposure to risks and impacts.
6	Conservation of biodiversity and sustainable management of living natural resources	Recognises that protecting and conserving biodiversity, maintaining ecosystems services, and sustainably managing living and natural resources are fundamental to sustainable development. While the Project will be located on future reclaimed land (i.e. highly modified habitat) in the SIPA, the standard is relevant for identifying opportunities to enhance habitat and protect and conserve biodiversity as part of the Project’s operation.

2.8.2 EHS Guidelines (general & industry specific)

The IFC EHS Guidelines provide further guidance on issues raised in the requirements of Performance Standards 3 and 4. The Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice. The *General IFC EHS Guidelines* (2007) contain general information on environmental, health, and safety issues potentially applicable to all industry sectors as well as performance levels and measures that are generally considered achievable in new facilities at reasonable cost through existing technologies.

In addition to the general guidelines, the IFC has developed the *EHS Guideline for Liquefied Natural Gas Facilities* (2017) which is considered applicable within the context of this Project as an accompanying document to the general Guidelines.

2.8.3 The Equator Principles

The Equator Principles (EPs) have been adopted by a wide range of banks and institutions all over the world in order to manage the social and environmental risks associated with potential investment. The guidelines are based on the environmental and social standards of the IFC and apply globally to development projects with a capital cost of US$10 million or more in all industry sectors. These principles are intended to serve as a common baseline and framework for the implementation of participating institutions’ internal environmental and social procedures and standards for project financing activities across all industry sectors globally. The ten principles are listed in Box 2.1.

The principles comprise the following:
Principle 1: Categorisation of projects
Principle 2: The borrower has to conduct an ESIA
Principle 3: Applicable Social and Environmental Standards
Principle 4: Action Plan and Management System
Principle 5: Consultation and Disclosure
Principle 6: Grievance Mechanism
Principle 7: Independent Review
Principle 8: Covenants
Principle 9: Independent Monitoring and Reporting
Principle 10: Equator Principles Financial Institutions Reporting

Box 2-1 Equator Principles

The latest version of the EPs is Version 4 (EP4) from July 2020, which came into force in October 2020. Notable changes in the EP4 include:

- a broadening of the scope of financial products to which they apply;
- a broadening of the application of E&S assessment; and
- a broadening across the application of international E&S standards.

EP4 refers in particular to the recommendations of the TCFD (Task Force on Climate-Related Financial Disclosure) for the assessment of climate-related risks and impacts and the consideration of the transition to a low-carbon economy as well as specific human rights risk assessment requirements.

The latest updates in the EP4 requirements were related to the Human Rights Risk Assessment (HRRA) (latest update in 2020) and the Climate Change Risk Assessment (CCRA) (latest update in May 2023).

The 2020 Guidance Note on HRRA include:

- Carry out initial scan of potential/actual project-level adverse Human Rights impacts using United Nations Guiding Principles methodology, noting which stakeholders could potentially be affected by which risks, if any.
- If results of initial screening point to lower risks, provide high-level statement of risks or comments in a form acceptable to the Equator Principles Financial Institutions (EPFI) for review.
- If results of scan point to higher risks, carry out additional research to understand risks and how they should be avoided, mitigated, and/or remediated. Include results in documentation for review by EPFI.
- Ensure assessment includes information on project level grievance mechanism.

Regarding the CCRA, the 2023 Guidance Note includes additional requirements compared to the 2020 Guidance Note as presented in Table 2-7.

Table 2-7 Main Changes from the 2020 CCRA Guidance Note to the Latest 2023 CCRA Guidance Note

CCRA 2020 Guidance Note requirements	CCRA 2023 Guidance Note additional requirements
■ Consideration of physical and transition risk	■ Consideration of physical/transition climate-related opportunities
■ Review of the Project's vulnerability and exposure	■ High-level quantification of the financial impact of potentially material risks (and financial materiality thresholds for the Project)
■ Identification of current and future anticipated risks which could be material to the Project	■ If financially material risks are identified – develop a Climate Change Risk Management Plan (CCRMP)
■ Consideration of management/mitigation measures which could impact risk materiality	■ The CCRMP will aim to ensure that risks are appropriately monitored, managed and considered within the Project's design

2.9 TotalEnergies' Corporate Standards

The ESIA process will be carried out taking into consideration the requirements of the following TotalEnergies' corporate 'General Specification' documents:

Table 2-8 TotalEnergies' Corporate Standards

General Specification Document	Description
Environmental Impact Assessment of E&P Activities (GS EP ENV 120)	The purpose of this specification is to define the processes and requirements for the preparation of an EIA study, and to provide the Contractor in charge of the study with instructions for its design and presentation.
Social Impact Assessment (GS EP SDV 102)	The purpose of this specification is to define the Company guidelines for conducting a Social Impact Assessment (SIA). It is the basic standard required by the Company and sets out the study content, phases and expected results. Local laws and rules must be respected, and further specific conditions added if necessary.
Social Baseline Study (GS EP SDV 101)	The purpose of this General Specification defines the Company requirements for establishing a Social Baseline Study (SBS). It is the basic standard required by the Company and sets out the study content, phases and expected results. Local laws and rules must be respected, and further specific conditions added if necessary.
Environmental Requirements for Projects Design and E&P Activities (GS EP ENV 001).	The purpose of this General Specification is to establish the environmental requirements for projects design and E&P activities. This General Specification applies to all operated affiliates and projects managed by the E&P branch of the Group.
Environmental Baseline and Monitoring Studies: Onshore Sites (GS EP ENV 111)	The purpose of the present General Specification is to define the technical instructions for compiling a detailed Scope of Work in order to establish the reference environmental status or to carry out environmental monitoring of an onshore site. This General Specification is the minimum standard required by Company. It should be adapted to each project in order to define a particular specification or Scope of Work.
Environmental Baseline and Monitoring Studies in Offshore and Coastal Waters (GS EP ENV 112)	The purpose of the present General Specification is to define the processes and requirements for conducting an environmental baseline study to establish the reference environmental status and for carrying out an environmental monitoring, offshore or in coastal waters. Otherwise stipulated by the regulation, this General Specification is the minimum standard required by the Company. It should be adapted to each project in order to define a particular specification, or Scope of Work.

General Specification Document	Description
GIS Deliverables for HSE (GS GR HSE 112)	This General Specification provides standards, procedures, and guidelines to ensure the proper Geographical Information System (GIS) data deliverable is generated and provided by contractors or consultants in the context related to Health, Safety, Social & Environment (HSE) studies as described in the GS EP ENV 111, GS EP ENV 112, GS EP ENV 120, GS EP SDV 101, and GS EP SDV 102. These studies are carried out to assess TotalEnergies environmental and social impacts when it comes to the development of new projects or closing out of existing projects according to the DIR-GR-HSE-004. It shall be used to ensure compliance with regards to data structure and governance for GIS deliverables.

3 PROJECT DESCRIPTION

3.1 Introduction

The LNG Bunkering Project (i.e., the Project) consists of an onshore plant treating quality gas to produce Liquefied Natural Gas (LNG), primarily dedicated to LNG bunkering activities but also to carriers loading at the Sohar Port in Oman. The LNG plant will be built on reclaimed land protected by an embankment and leased by the Sohar Industrial Port Company (SIPC).

From a design perspective, the main project concept has been selected and the Front-End Engineering Design (FEED) has been done to develop the Project concept.

The purpose of this Project Description is to describe the conceptual design features (as defined by the current stage of the design) and to support in the identification of the environmental and social effects related to the Project's construction, commissioning, operation, maintenance, and decommissioning phases.

The main characteristics of the Project are described in the following sections.

3.1.1 Project Overview

The Project will consist in the following key elements:

- **LNG Plant:** consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to liquefy the Natural Gas inlet and produce LNG. Further details are provided in Section 3.3.1.
- **Condensate Export Pipeline:** comprising a short pipeline (<1km) that will supply condensate (a by-product of the LNG Plant production) to ADVARIO's tank farm (former Oil Taking Terminal (OTT)) for future use by another industry within the Sohar Port (i.e., OQ Refineries and Petroleum Industries LLC - OQRPI). Outside of MARSA LNG LLC's fence, the condensate export pipeline will cross an existing pipeline corridor within the port to reach the tank farm fence which is located approximately 100 m from the fence. Around 10 m of the pipeline may be buried and the rest will be above ground on the existing/upgraded pipe rack. While the pipeline construction, tie-in to ADVARIO's tank farm and commissioning will be completed by an EPC Contractor of MARSA LNG, the operation and maintenance of the pipeline will be the responsibility of MARSA LNG. Further details are provided in Section 3.3.2.
- **Electrical Transmission Line:** comprising an approximately 3.5 km-long buried electrical cable that will connect the LNG substation with the existing Substation operated by Oman Electricity Transmission Company (OETC) within the Sohar Port. The installation, termination and connection between the two substations will be undertaken by MARSA LNG LLC's EPC Contractor. Operation and maintenance of the LNG substation as well as the underground transmission line will be the responsibility of MARSA LNG. Further details provided in Section 3.3.2.
- **Topside of the LNG Export Jetty:** the jetty subsea foundation and access road will be designed and built by SIPC and is outside the Project's scope. However, the jetty topsides (operational area) will be completed by MARSA LNG LLC's EPC Contractor and is part of the Project' scope. The topside elements required for loading include a pipe rack, process manifolds, LNG loading arms, safety measures, and a jetty control station. The operation of the jetty topsides is within the Project' scope, while the substructure maintenance and mooring operations remain within SIPC's scope of work. Further details provided in Section 3.3.2.

The yearly LNG Plant capacity is around 1 Million Ton Per Annum (MTPA). The gas will be delivered at the expected average rate of 150 Million Standard Cubic Feet per Day (MMSCFD) to the Plant inlet. The nominal (i.e., typical) flow rate will be of 158 MMSCFD considering the LNG Plant availability.

The gas to be delivered and processed at the LNG Plant will be supplied through the OQGN network, which is Oman's exclusive gas transportation system operator. The volume of feed gas to be liquefied in the LNG Plant corresponds to MARSA LNG LLC's gas equity produced by the upstream Block 10, operated by Shell Development Oman (53.4% equity) in a joint venture involving MARSA LNG LLC (33.2% equity) and OQ, the state-owned energy company of Oman (13.4% equity). The fluids produced from Block 10 are combined and processed with other production streams from different blocks at the Saih Rawl central processing plant, owned by Energy Development Oman SAOC (EDO) and operated by Petroleum Development Oman (PDO). The processed gas is then introduced into the national gas pipeline network at the processing plant's outlet, while the condensates are transported to the Muscat terminal via the Oman MOL (Main Oil Line). Block 10 achieved its first gas production milestone in January 2023, and currently sells the gas to the government through an interim Gas Sale Agreement valid until 2041. Through its 33.2% equity on Block 10, MARSA LNG LLC will have the right to take 150 MMcf/d from the domestic network to supply the LNG Plant. However, the gas that will be treated at the LNG plant will not directly come from Block 10, as different gas field feed the national gas transportation system between the Block 10 location and the Sohar port. Without MARSA LNG LLC's LNG Plant, gas produced by Block 10 would continue to be supplied to the domestic network and industrial gas consumers, including the Qalhat LNG Terminal.

As mentioned above, the feed gas will be pre-treated upstream of the LNG plant site before being delivered to the LNG plant by OQGN's existing pipeline network. Additional pre-treatment will be required at the LNG plant further refining the gas for export. Upon arrival to the inlet facility, the feed gas will flow through an inlet facility made of a series of filters to remove black powder and a let-down unit that will reduce the gas pressure and temperature. Filtered feed gas will flow through a mercury-removal unit to prevent mercury amalgam corrosion (or liquid metal embrittlement) of aluminium equipment in the cryogenic sections of the plant. Carbon dioxide (CO_2) will be removed by an Acid Gas Removal Unit (AGRU) through an absorption process using an amine solution. Water will be removed to prevent hydrate and ice formation in the cryogenic section using a dehydration unit with regenerative molecular sieve beads. Heavy hydrocarbons and benzene that can freeze in the cryogenic section will be removed to produce Condensate (by-product) that will be exported through the Condensate Export Pipeline.

The LNG produced in the plant will be sent to an onshore storage tank, before being loaded to bunkering vessels or LNG carriers via a dedicated LNG marine terminal (jetty and associated LNG loading system). The construction of the subsea part of jetty is outside of the Project' scope and will be developed by SIPC directly. While the vessel traffic for users is not part of the Project' scope, it is considered as an associated activity for the scope of the ESIA; therefore, the activities associated to marine traffic, vessel movements and operations inside the port area are part of the scope of this ESIA.

All vapours generated during loading system will be returned to the Boil-off Gas Recovery System of the facility, compressed, and send back to the LNG train.

To minimize the impact of Project activities, a Carbon Footprint Reduction exercise has been carried out to identify GHG reduction initiatives for the Marsa LNG project. The solutions that have been selected at a design stage of the Project are summarized in Section 3.3.1.1. A block flow diagram presenting the inputs and outputs of the LNG plant is presented in Section 3.3.1.

3.1.2 Project Location

The Project will be located in the Sohar Industrial Port, situated approximately 220 km northwest of Oman's capital city of Muscat. The Project site is located just outside the Strait of Hormuz. The Sohar Port is in a favourable location for trade and cargo handling in and out of the Arabian Gulf, and on a major shipping route between Europe and Asia.

The Project site is located in a port expansion area already reclaimed and leased by SIPC (Figure 3-1). The reclaimed land was part of the Sohar Port Reclamation Project managed by SIPC and is located between the existing harbour breakwater and Majis Industrial Services Company S.A.O.C. (MISC) Seawater Intake (SWI). On the other hand, the jetty subsea structure construction will be managed by SIPC and is not part of the Project' scope.

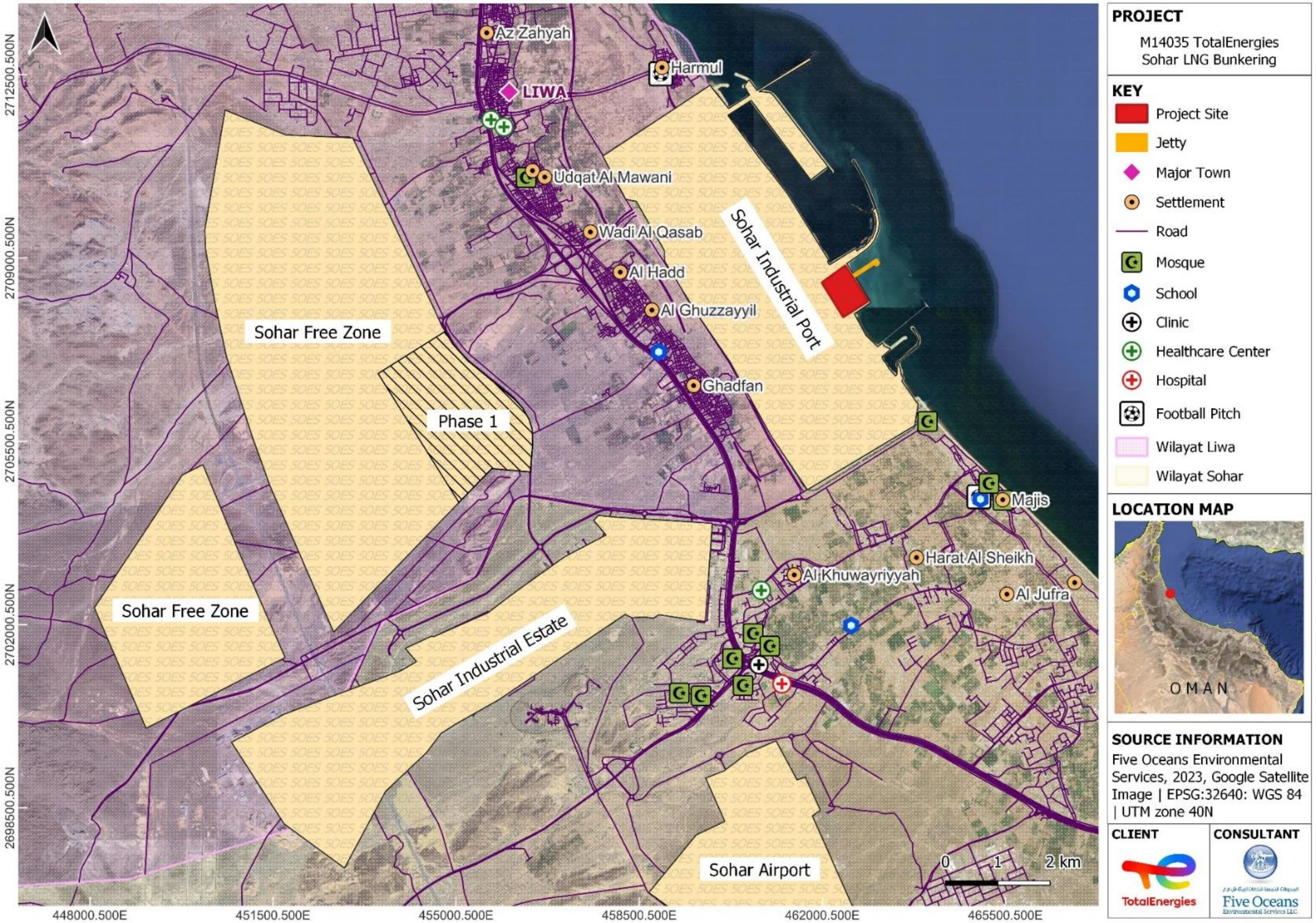


Figure 3-1 Project site and surrounding infrastructure

3.2 Project Schedule

The Project schedule includes the following three phases:

- *Construction, pre-commissioning and commissioning phase (Phase 1)*: includes civil works, construction of buildings and installation of temporary site facilities, as well as mechanical and electrical works. The LNG Plant construction activities are planned to take approximately 34 months including pre-commissioning and commissioning phases. Currently it is foreseen that the main construction activities will start in the third quarter of 2024 and will be concluded with the start-up of the plant in mid-2027. The commissioning phase will last 15 months and will start by the first quarter of 2026.
- *Operations and maintenance phase (Phase 2):* From the LNG plant start-up, the operation will commence and involve periodic maintenance activities at the Project site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- *Decommissioning phase (Phase 3)*: At the end of the planned operational lifetime, the operation of the Project facilities and associated infrastructure will be reviewed and either extended or decommissioned. Decommissioning will involve the removal and reuse / recycling / disposal of surface structures and the reinstatement and restoration of the affected sites.

3.3 Project Components

This section provides an overview of the key project components associated with the Project including:

- LNG Plant;
- Pipelines and transmission lines;
- Associated facilities; and
- Accommodation camps and other facilities within the area of influence.

3.3.1 LNG Plant

A conceptual layout (plot plan) of the LNG Plant is provided in Figure 3-2.

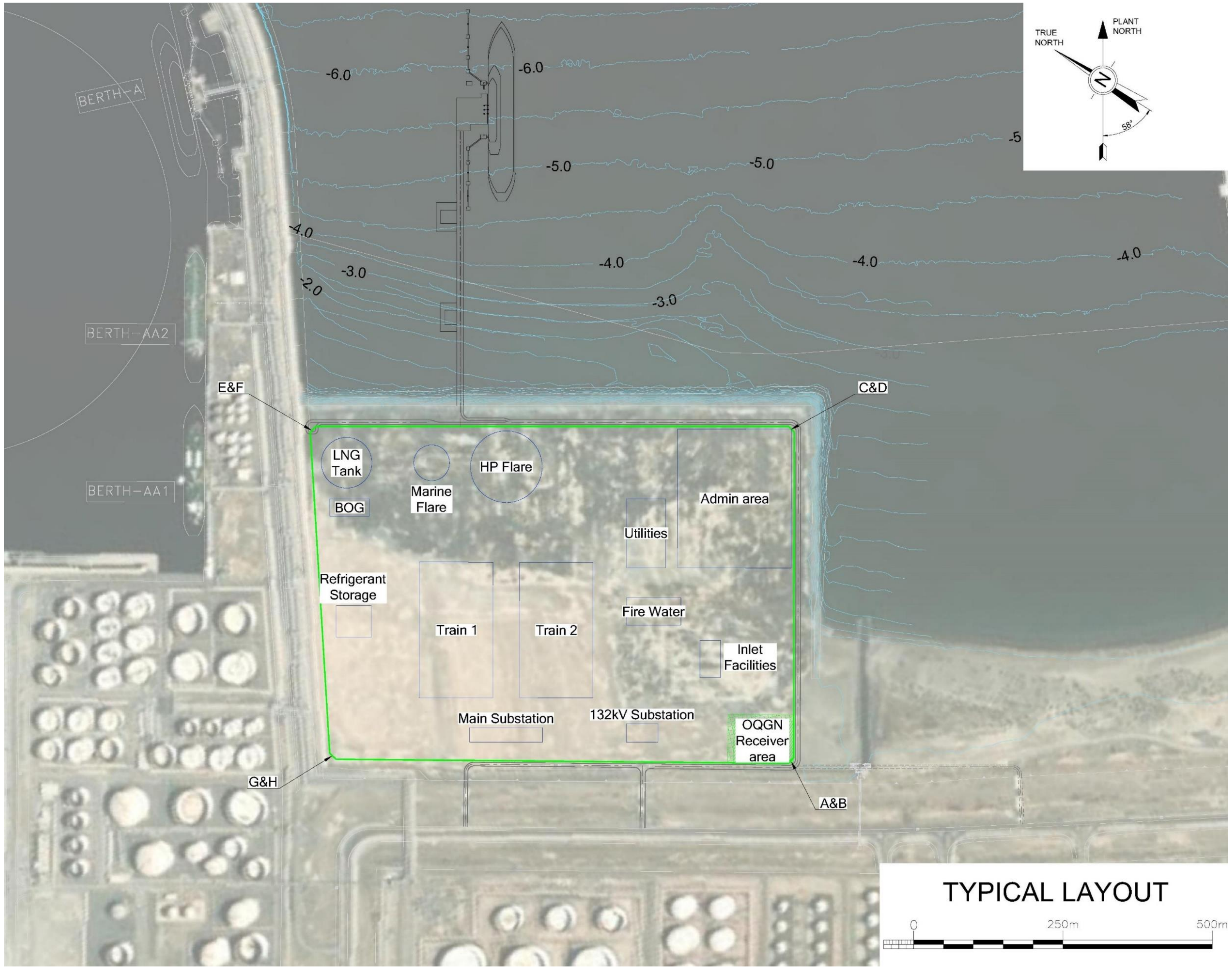
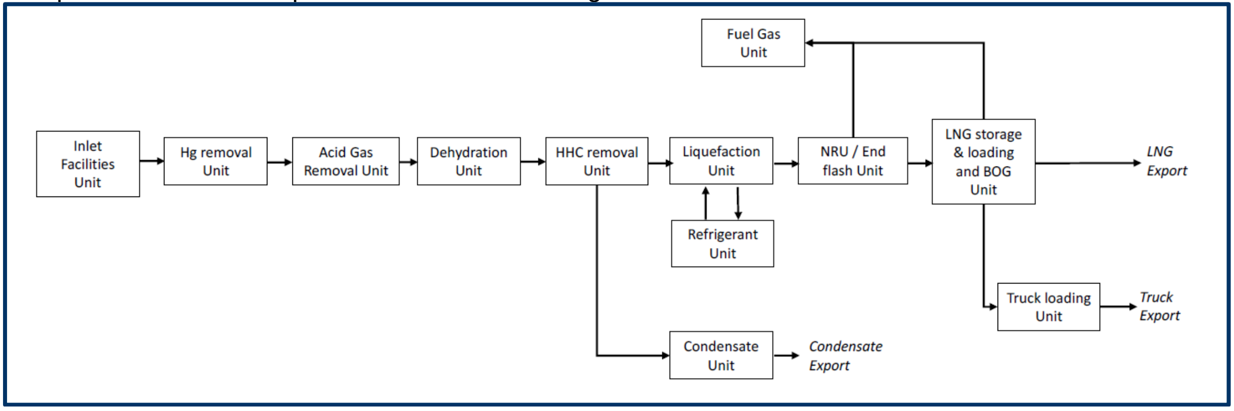


Figure 3-2 Indicative Layout of the LNG Plant

The process in the LNG plant is summarized in Figure 3-3.



Source: MARSA LNG LLC - Process Basis of Design, OM-SOH-00-TOTA-000027.

Figure 3-3 LNG Plant Flow Diagram

3.3.1.1 Carbon Footprint Reduction Initiatives considered for LNG plant

To minimize the impact of Project activities, a Carbon Footprint Reduction exercise has been carried out to identify GHG reduction initiatives for the Marsa LNG project. Among the solutions that have been selected at a design stage of the Project are:

- The plant has been designed as a zero-flaring plant, where all the normal flaring base line emitters (flare header purging, compressor seal gas vents) have been eliminated. In addition, the following design solutions have been considered:
  - to reduce the natural gas flaring amount, thanks to the small size of the facility and its location in a middle of an industrial area, a methodology using nitrogen has been developed. This methodology has most benefit for the initial start-up but can also be applied after every major shutdown. The methodology consists of starting up the facility under nitrogen and to perform the defrosting operations with it.
  - to achieve a zero-flaring design, Marsa LNG has implemented the recovery of its compressor seal gas for major compressors which use seal gas.
  - The design put in place will include the best-in-class passing valve design with an applied latest guidance on passing valve identification/ repair. Any identified passing valves can be repaired promptly online under temporary operating procedures.
- A thermal oxidizer has been selected to combust traces of methane remaining in the vented nitrogen of the NRU. The methane will then be converted into CO2, significantly reducing the associated emissions.
- MR refrigerant composition adjustment valves will not be routed to flare but back to the process which will also prevent flaring in case Main Cryogenic Heat Exchanger leaks develop as these will be recovered instead of being sent to flare.
- All compressors in the LNG plant will be driven by electric motors and the electricity will be drawn from the existing OETC's substation through the Electrical Transmission Line.

3.3.1.2 Components and key utilities of the LNG plant

The LNG plant will include the following components:

- **Inlet Facilities**: which will include a pressure control station, a filter to remove the particulate matter, and an overpressure protection system.

- **Mercury Removal Unit**: an adsorption system aimed to remove potential mercury present in the feed gas and to avoid mercury amalgam corrosion or liquid metal embrittlement of aluminium equipment in the cryogenic sections of the plant.
- **Acid Gas Removal Unit (AGRU)**: the gas from the mercury removal unit will be sent to the AGRU to remove acid gases (mainly CO_2) to prevent freezing in the cryogenic section. The CO_2 removal will be done by absorption in an amine-based solvent.
- **Dehydration Unit**: it will dry the gas flow to an acceptable level to prevent water freezing and hydrate formation in the cryogenic sections of the LNG plant. The gas will be cooled and then sent to an adsorption unit filled with molecular sieve (three beds, two in operation and one in regeneration).
- **Heavy Hydrocarbon (HHC) Removal Unit**: it will remove heavy hydrocarbons and benzene from the feed gas to a level that prevents freeze out in the liquefaction unit. The HHC Removal Unit will include a demethanizer. The treated gas from the demethanizer overhead will be compressed up to the required liquefaction pressure by a booster compressor. From the bottom of the column, the Natural Gas Liquids (NGL) will be extracted (low-density mixture of hydrocarbon liquids). The condensate will be stabilized in a dedicated downstream unit called the Condensate Stabilization Unit.
- **Liquefaction Unit**: it will cool and liquefy natural gas product. The gas from the HHC Removal Unit and recovered from the Condensate Stabilization Unit will be liquefied in a cryogenic heat exchanger. The LNG product will exit the unit at approximately -150 °C. The refrigerant used for the liquefaction will be a mix of light hydrocarbons and nitrogen. Chilled water production may use the following refrigerant: R134a, R410A, HFO or R717 (ammonia). For the air-cooling system, the following refrigerant may be used R134a, R513A, R410A, R32. The operations are intended to use non-ODS (ozone depleting substances) refrigerants and specifically those with a low global warming potential (GWP) (i.e., non-hydrofluorocarbon (HFC) refrigerants). A dedicated storage for the refrigerants (Refrigerant Unit) will be provided with a capacity equal to two (2) times the total inventory of the liquefaction loop.
- **Nitrogen Rejection Unit (NRU) and End Flash Gas Unit**: Nitrogen content in the LNG will be decreased to respect the LNG specifications. The NRU will consist of cryogenic distillation. A by-product stream of nitrogen will be produced: part of it will be emitted to the atmosphere while another part recycled to the process or used for the LNG plant needs. The N_2 vented will be sent to a thermal oxidizer to eliminate the fugitive methane emission that could be present in the nitrogen (NRU Incinerator).
- **LNG Storage and Unloading Unit:** The LNG produced will be stored in an onshore tank. The LNG tank will have a capacity of 165,000 m^3. The LNG will be loaded to the vessels through dedicated pumps and loading arms suitable for both bunkering vessel and LNG carrier loading. There will be connections to a standard future LNG truck loading unit with the following characteristics: 3 loading bays for tankers and ISO containers.
- **Boil-Off Gas (BOG) Unit:** the boil-off gas produced during storage and unloading operations will be recovered and recycled in the process.
- **AGRU Incinerator:** it will be used to treat the off-gas from the AGRU characterized by the presence of limited quantities of hazardous substance such as Benzene and H_2S. The off-gas will be incinerated in a Regenerative or Recuperative Thermal Oxidizer.
- **Flare System:** it is provided for the reliable and safe disposal of vapour and liquid streams that result from emergencies. In addition, the flares are also capable of handling hydrocarbon streams that result from operating conditions such as start-up and shutdown.

Since the LNG Plant will handle a variety of fluids with different properties and at different operating conditions, they cannot be mixed all together. This implies that, depending on the fluids and their qualities, fluids have to be segregated and collected into separate disposal systems. Thus, the design of the hydrocarbon disposal system is based on the segregation of the following streams:

- Wet and warm hydrocarbon releases (for the warm section);
- Dry (water-free), potentially cold hydrocarbon releases; and
- Low-pressure dry and cold releases from the LNG storage and loading system.
- Flaring will be only allowed during start-up, shut down and in emergency situations.
- In total, four (4) flares will be present at the site, including:
- Warm flare, cold flare and a common spare flare which will be mounted on a common derrick; and
- A low-pressure (LP) cold flare dedicated to the storage and loading operations.

"Multi-arm with variable slot high-pressure (HP) flare tip" technology valued for high combustion efficiency and non-assisted smokeless operation will be used for the flare system. Thanks to this technology, no steam injection is foreseen.

The LNG plant will also include the following key utilities:

- **Electricity:** The power will be provided by a future solar PV plant (at remote location/feeding the existing grid). The LNG plant will be connected to the network via a buried electrical cable. MARSA LNG will produce/purchase the carbon credits from the solar power plant for its carbon neutrality (scope 2).
- **Fuel Gas:** The fuel gas system will be low pressure and will serve the entire facility. The main sources of fuel gas will be:
  - AGRU flash gas;
  - Boil Off Gas (BOG) from the onshore tank;
  - Fuel Gas make-up that will preferably be taken downstream of the dehydration unit.

  The fuel gas will be supplied to the site through a dedicated network and will be used by the AGRU and NRU incinerators and the flares pilots.
- **Nitrogen:** it will be used for plant operation and maintenance and will be recovered from the NRU as Liquid Nitrogen and Gaseous Nitrogen. Typically, nitrogen will be used as blanketing gas, purged gas, rotating machines seal gas and also as sweeping gas (e.g., for the flare). Unless necessary, no nitrogen will be imported during operation as nitrogen will be extracted from the feed gas. Recovered nitrogen will be either under gaseous form, so-called Gaseous Nitrogen (abbreviated as GAN), or under liquid state, so-called Liquid Nitrogen (abbreviated as LIN).
- **Service water:** Both process and potable water will be provided to the LNG Plant by an external party inside the Sohar Port. Service and fire water will be stored within the same tank.
- **Demineralized water:** Demineralized water is required for the AGRU operation. A demineralized water package is foreseen with a dedicated tank at site.

In addition, the LNG plant will have a backup diesel generator to supply a minimum number of consumers in case of shutdown, and a fire prevention system.

The site activities will be conducted and monitored through a dedicated control room. The building will be equipped with all the devices needed to ensure continuous operation in any conditions as UPS, battery system, Heating, Ventilation, and Air Conditioning (HVAC) system, communication system, etc. The Jetty operation will be monitored in a separated control building.

The main egress to the LNG plant will be via the security gate or house.

Other buildings to be constructed include administrative offices, warehouses, maintenance workshops, a small medical facility, fire station, laboratory and the chemical storage warehouse, hazardous waste storage area.

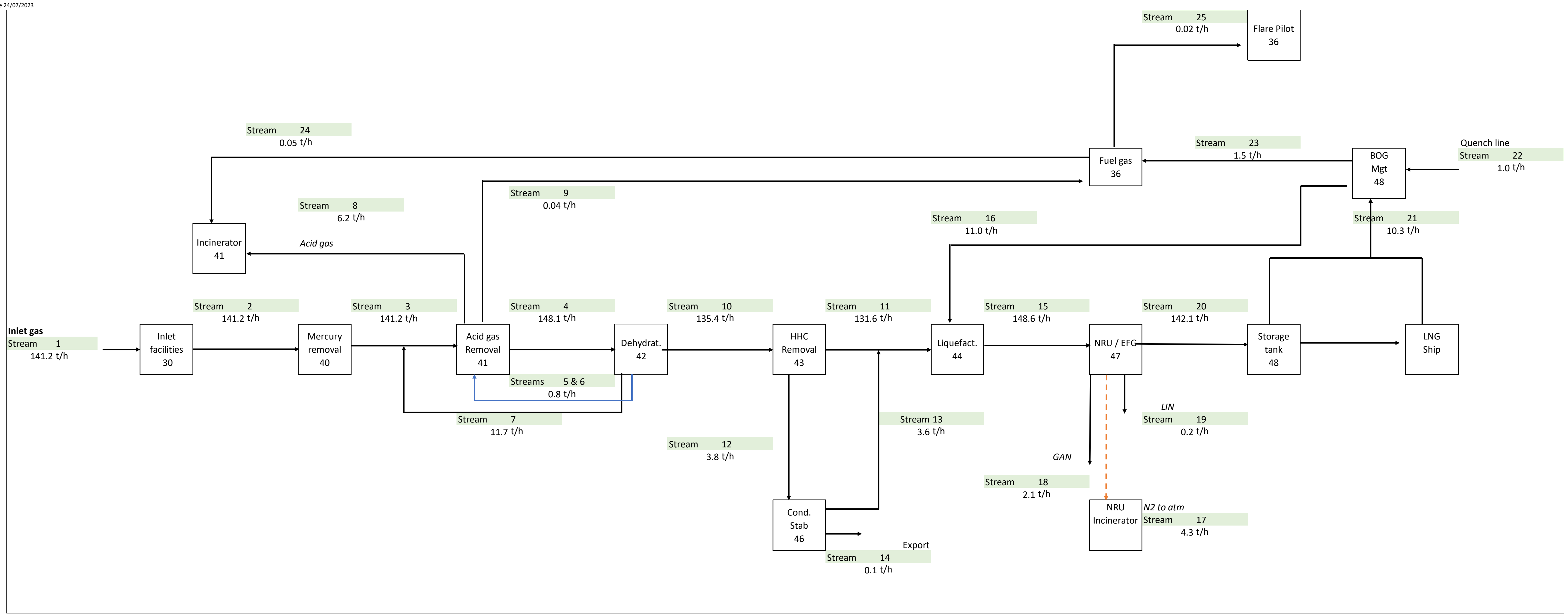
No specific wastewater treatment unit will be needed on site (see details in Section 3.7.11).

A process flowchart containing major and sub-processes and how they are interconnected, and their mass balance is presented in Figure 3-4.

TOTALENERGIES

MARSA LNG Project

Date 24/07/2023



Stream 1	Inlet Feedgas	Stream 9	Flash gas from rich amine flash drum	Stream 17	N2 vent to ATM	Stream 25	Fuel gas to flare (pilots only)
Stream 2	Feedgas to Mercury	Stream 10	Dehydrated gas	Stream 18	Gaseous nitrogen (GAN)		
Stream 3	Demercrurized gas to AGRU	Stream 11	Lean gas	Stream 19	Liquefied nitrogen (LIN)		
Stream 4	Sweetgas to HHC	Stream 12	C2+ stream	Stream 20	LNG rundown		
Stream 5	Water rfrom Dehydration unit	Stream 13	LPG reinjection	Stream 21	Boil-off gas (BOG)		
Stream 6	Water rfrom Dehydration unit	Stream 14	Condensates export	Stream 22	LNG quench		
Stream 7	Regeneration gas to AGRU	Stream 15	LNG	Stream 23	Boil-off gas to Fuel gas system		
Stream 8	Acid gas to incinerator	Stream 16	BOG recycle	Stream 24	Fuel gas to incinerator		

Non-Routine Flaring expected as follows:

Warm section start-up: 60t/h during 3 hours (6 times a year)

Liquefaction section start-up: 58t/h during 12 hours (6 times a year)

EFG/NRU section start-up: 22t/h during 24 hours (6 times a year)

Source: MARSA LNG LLC, 2023.

Figure 3-4 LNG Plant process diagram and mass balance

3.3.2 Pipelines & Transmission Lines

The following pipelines and transmission lines are part of the Project's components:

- **Condensate Export Pipeline**: comprising a short pipeline that will connect the LNG plant with the former Oil Taking Terminal (OTT) site (now ADVARIO), where condensates will be stored for future use by an industry within the Sohar Port (see Figure 3-5).
- **Transmission Line:** comprising an approximately 3.5 km-long buried electrical cable will connect the LNG substation with the existing Substation operated by OETC within the Sohar Port. The installation, termination and connection between the two substations will be undertaken by MARSA LNG LLC's EPC Contractor. Operation and maintenance of the LNG substation as well as the underground transmission line will be the responsibility of MARSA LNG.

For further details of the proposed respective routes for the pipeline and transmission line refer to Figure 3-5.

3.3.3 Associated Facilities

Associated Facilities (AFs) to the Project are those infrastructures that would not have been constructed or expanded if the Project did not exist, and without which the Project would not be viable.

The AFs considered for this Project include:

- An extension to the **OQGN feed gas pipeline**: the existing OQGN network will be extended by approximately 2.5 km, to feed the LNG Plant with natural gas coming from the upstream Block 10 up to a Receiver Station operated by OQGN nearby the LNG Plant. The pipeline extension will be buried and will run within an existing pipeline corridor within the port. The construction, operation and maintenance of the pipeline will be performed by OQ GN and is not part of the Project' scope.
- The marine component of the **Jetty:** the subsea part of the Jetty will be designed and built by SIPC and is not part of the Project' scope. As base case, it will be around 450-500 m long and equipped with a 4-m wide road. On the other hand, the jetty topsides (operational area) will be completed by the MARSA LNG LLC's EPC Contractor and is part of the Project' scope.
- The **solar plant** is planned to be constructed in a separate plot to supply power to the LNG Plant during operation. The solar plant will be connected to the grid network and from there, energy will be procured for the LNG Plant. The LNG plant will consume around 44% of the energy produced by the Solar Plant during the day through power wheeling agreements with OETC for usage of their grid network for power supply. Nighttime electricity will be procured from the OETC Grid through the same dedicated power connection. Since the Solar plant will be producing the entire energy needs of the LNG plant during the day itself, there will be an excess of around 56% during the day which will be sold on the Omani spot market. The solar plant is not part of the Project's scope and it will be evaluated in a separate and dedicated ESIA. However, considering that it is built as an offset GHG Scope 2 emission solution for the Project, the potential cumulative impacts associated to the construction and operation of the solar plant have been assessed as part of the Project's impact assessment.

The new terminal will have the capacity to load LNG bunker vessel sizes between 7,500 and 20,000 m^3. It is also proposed that the berthing facility shall be designed for export LNG Carriers up to 185,000 m^3. SIPC will construct the jetty structure starting from the reclamation boundary (not part of the Project' scope).

The scope of work for the LNG Jetty includes, but is not limited to, the following:

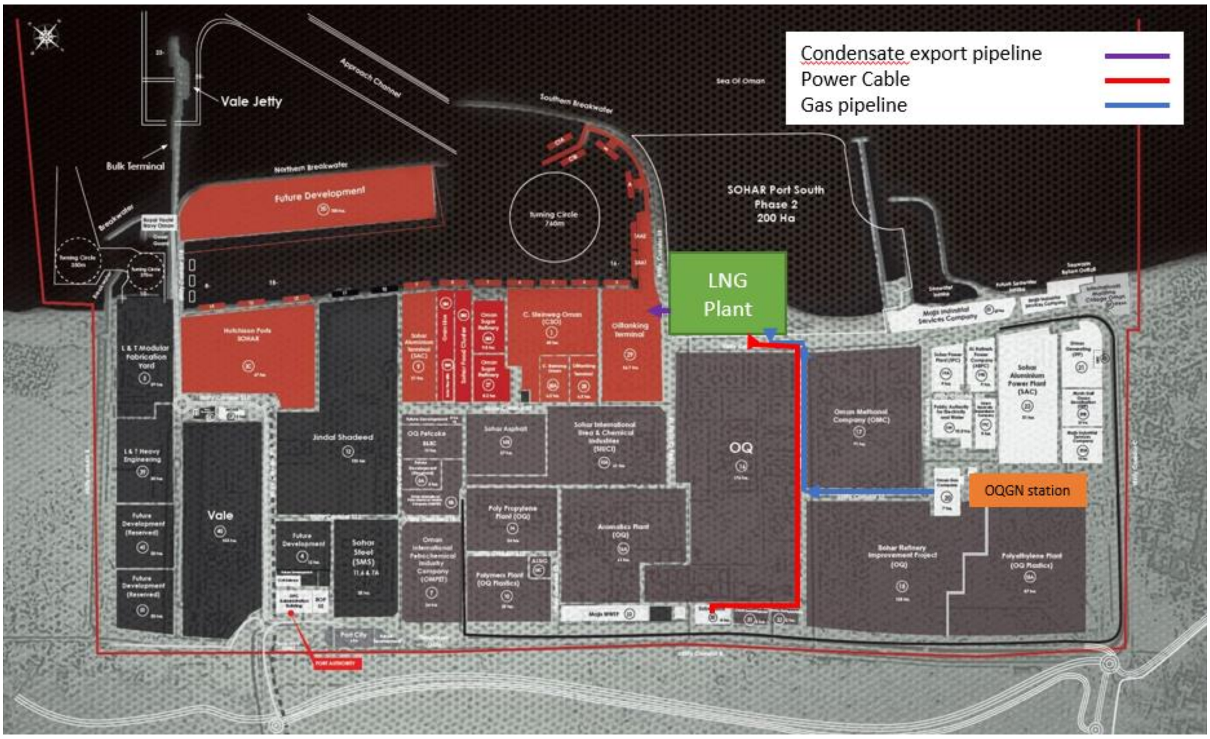
- Berthing and mooring dolphins including access walkways, and
    - Fendering;

- Quick Release Mooring Hooks (QRMH), with capstan and provision for load tension monitoring and remote release.
- Safety equipment e.g. safety ladders;

- Operating/loading platform with associated handrails and vehicle barriers.
- Protection of steel piles / structures against brittle fractures in case of LNG spills.
- Approach trestle, including access roadways, pipe trestle, maintenance walkways and all associated hand railing and vehicle barriers.
- Landside abutment structure (connection points between approach trestle and reclamation revetment).

The design and installation of pipelines, equipment, utilities, access from LNG terminal to jetty and landside pipe crossing culverts/bridge works will be under MARSA LNG LLC's scope.

Figure 3-5 shows the expected location of the condensate export pipeline and transmission line (project components), as well as the feed gas pipeline (associated facility – not part of the project' scope) to be connected to the LNG Plant.



Source: MARSA LNG LLC, 2023.

Figure 3-5 Pipelines and Power Cable Associated to the LNG Plant

3.3.3.1 The Jetty

The LNG Loading terminal will have the capacity to load LNG bunker vessel sizes between 7,500 and 20,000 m^3. In the first years, according to the market requirements, the LNG terminal will also load LNG Carries up to 185,000 m^3.

The LNG terminal will consist of an approach trestle supporting an access road and a pipe rack, a loading platform supporting equipment and loading arms, berthing and mooring dolphins.

The loading platform dimensions will be approximately 50 m by 50 m. These dimensions will allow for the loading equipment, operation control, ship access and firefighting.

The platform will be accessible to vehicles and crane for light maintenance. No heavy maintenance is foreseen at the platform site.

The berthing and mooring dolphin will be equipped with Quick Release Mooring Hook (QRMH) to fulfil the berthing and mooring requirements.

SIPC will construct the jetty structure and mooring means starting from the reclamation boundary, and MARSA LNG LLC will complete the construction with the installation of all the required equipment. In particular, MARSA LNG LLC will install the following:

- Topsides of the operating/loading platform with manifold, loading arms, tower crane and telescopic ladders, and all safety equipment; and
- Pipe trestle lending on substructure installed by SIPC, maintenance walkways and all associated handrailing.

The design and installation of pipelines, equipment, utilities, access from LNG terminal to jetty and landside pipe crossing culverts/bridge works will be under MARSA LNG LLC's scope.

The loading system (loading pumps, lines and arms or flexibles) will be designed for loading both to bunker vessels and LNG carriers, specifically:

- To bunker vessels, with a flowrate of maximum 2,000 m^3/h; and
- To LNG carriers, with a flowrate of 6,000 m^3/h.

The loading arm operation will be performed by Marsa LNG LLC. All shipping operations (approach, berthing, mooring) will be performed by SIPC.

3.3.4 Accommodation Camps & Other Facilities within the Area of Influence

The Sohar Port area and Freezone Port Area (see Figure 3-8) are already developed and include facilities and infrastructure that will be utilised by the Project. Some of these will be used directly, such as the existing accommodation camps and laydown areas or warehouses in the Freezone Port Area, the water supply network, waste and wastewater treatment facilities, existing roads etc. at the Sohar Port Area. Other roads will be slightly modified in order to reach the LNG plant, including access road to the site or small modifications to the port substation in order to accommodate the new transmission line.

The existing accommodation camps are located outside of the Sohar Port and the Freezone Area. Accommodation within the city of Sohar will be provided to the expatriates and for other non-Omani personnel. Accommodation for the local Omani workforce will be either in the same accommodation as the expatriates or if they live in the local area, they will reside in their personnel residence.

Facilities at the accommodation camps include rooms, dining (mess hall and kitchen), medical, laundry and recreation areas. The same existing accommodation camps are proposed to be used during all project phases (construction, operation and decommissioning). As part of the Sohar Port Reclamation Project, a non-asphalt road will be constructed to access the LNG Plant area and will be used for the construction phase. As such, it is not considered part of the LNG Bunkering Project' scope. This road will be upgraded to asphalt at the end of the construction for the operation phase.

3.4 Construction, Precommissioning and Commissioning Phase

The main impacting Project activities to take into consideration during the construction, precommissioning and commissioning of the entire set of project facilities and utilities are listed below and described in the following subsections.

- Civil works for construction, including excavation works, terrain levelling and compacting, foundation and basement laying.

- Depending on the quality of the existing reclaimed area, some soil improvement might still be required such as deep soil improvement and/or stone columns. Then, standard pilling and shallow foundations would be installed to support plant infrastructure.
- Temporary Site Facilities Construction of buildings (maintenance building, security huts, offices, etc.).
- Set up and installation of facilities and associated infrastructure.
- Mechanical and electrical works (e.g., tie-in).

The potential impacts of this phase are mainly related to the following activities:

- Earth moving for construction and clearance;
- Movement of vehicles, equipment, personnel and supplies;
- Movement and storage of construction materials;
- Storage and handling of fuels and chemicals;
- Waste management;
- Presence of workers in the surrounding areas.

The activities will involve mobilisation, site clearance and preparation (infilling), construction of onshore facilities, completion of the jetty, pre-commissioning and commissioning of the LNG Plant. Further details of each of the activities is provided in the sections below. The use of resources and environmental interferences during this phase is described in Section 3.7. The number of personnel foreseen during the construction and commissioning phase is provided in Section 3.8.1.

3.4.1 Mobilisation Activities

The mobilisation activities will consist of the heavy equipment transportation through main existing transportation routes, while raw materials will be sourced locally, wherever possible. Pipeline components, packages and main containers will be shipped to the Sohar Port and then transferred to the relevant locations by trucks.

3.4.2 Onshore Facilities Construction Activities

Considering that the plant site is located on reclaimed land already levelized, only minor activities are expected before the main construction activity, mainly related to Land Surveys (geotechnical and geophysical).

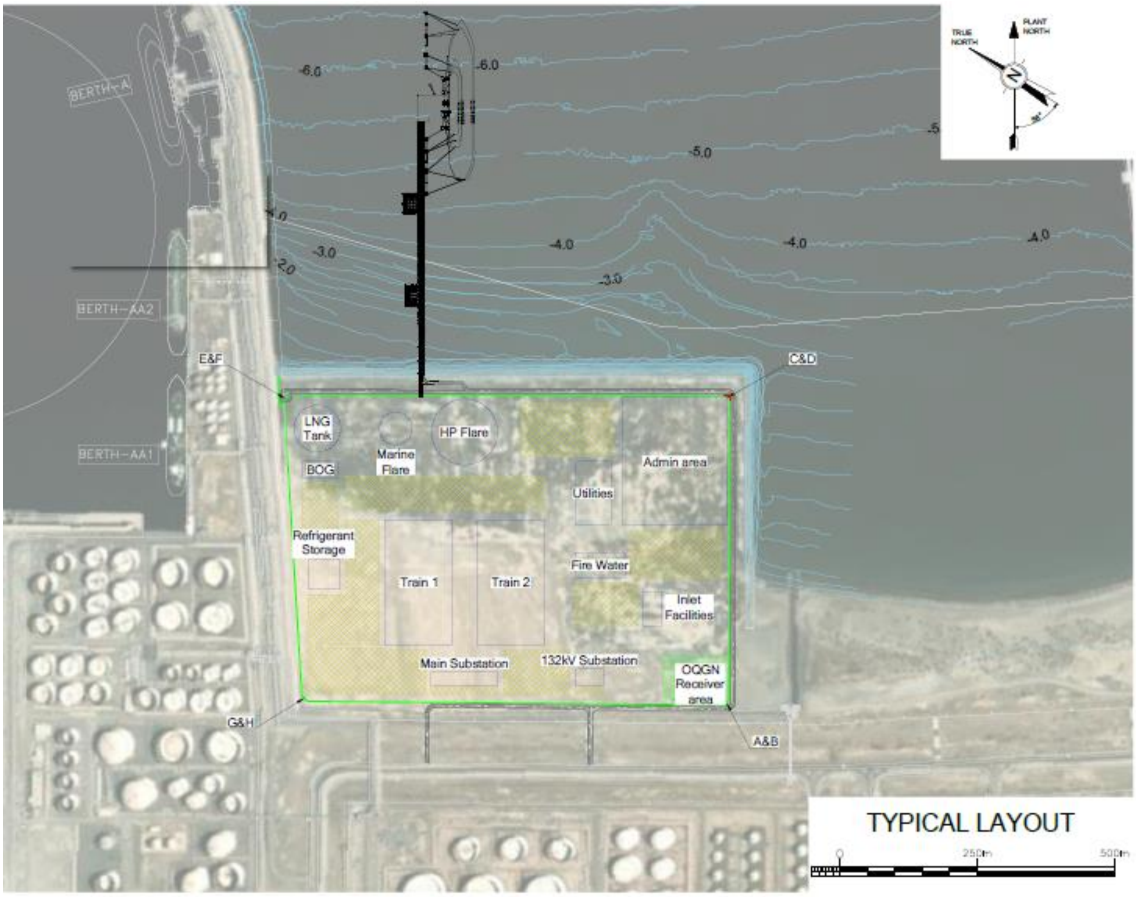
If required, soil improvement will be performed below mainly the LNG Plant area where the two trains are located and the LNG Tank area (see Figure 3-2).

Following the minor activities described above, the construction of onshore facilities will start.This will include laying of concrete slabs, buildings construction, and plant and storage areas construction. In addition, the storm water and wastewater collection systems will be installed across the site. The construction of the onshore facilities will require use of cranes, trucks, generators, earthworks vehicles, piling equipment and concrete mixers. After construction activities, and during operations, the LNG Plant site and the onshore facilities will be permanently fenced for security and safety reasons, following MARSA LNG LLC’s HSE standards, Omani requirements and SIPC rules.

Infrastructure required during the onshore facilities construction will include the following:

- Temporary Work Sites and Storage Areas within the LNG site (see Figure 3-6).
- An additional temporary construction / laydown area and warehouse will be rented by the EPC in the neighbourhood of Port Area.

The considered options for the external laydown areas include the following industrial sites: STS, Arabian Industry (AI), SIPC Freezone.



Source: TotalEnergies, 2023

Figure 3-6 Temporary Facilities within the LNG Site

3.4.3 Jetty Installation

Once the subsea elements of the jetty have been constructed by SIPC (not part of the Project' scope), MARSA LNG LLC will install the Topside elements required for loading including pipe rack, process manifolds, LNG loading arms, safety means, jetty control station, etc. All these elements will be installed from the jetty itself and will not necessitate any marine means (e.g. lifting crane barge etc.).

The activities foreseen are mainly related to the mechanical installation of the equipment and piping. No soil movement is foreseen.

An example of the future jetty is shown in Figure 3-7.

Figure 3-7 An Example of the Jetty

3.4.4 Condensate Export Pipeline Installation

The condensate export pipeline will be installed within existing corridors. Corridors are already cleared of vegetation and dedicated to industry needs for interconnections. The pipeline can be either buried or will be installed above ground. A part of the corridor will be allocated as a permanent Right of Way (RoW).

The pipeline construction follows a sequential process comprised of a number of distinct operations carried out in sequences by different, highly specialized crews from RoW preparation, excavation/civil work (if buried), pipe stringing, welding, blasting, backfill (if buried), hydrotesting and commissioning.

The pipeline construction activities foreseen for this Project are described below.

1. In case of a buried pipeline:

- **Preparation of the working strip**: Existing topsoil (only small quantities expected considering the characteristics of the selected route), will be stripped from the RoW areas by suitable earth moving equipment and stockpiled at a designated storage location at a minimum distance from the edge of the excavation. Where present, the topsoil stockpile will be typically no higher than 2 m to prevent degradation of the soil, and it will be kept free from disturbance to reduce the possibility of physical damage and compaction. The working strip will be levelled, using suitable construction equipment (pickup trucks, loaders, dozers, shovel and backhoes, blades), to eliminate large stones, irregularities and other features.
- **Pipe stringing and bending**: The pipeline will be constructed using sections of steel pipe. Sections will be transported to the working place from the construction yard and positioned along the existing corridors using suitable side-booms and tracked vehicles. Pipe sections will be unloaded with a mounted pipelayer crane and placed end-to-end according the selected route. Where necessary, the pipe in place will be cold bended to match or pipeline changes of direction. Usually, a hydraulic bending machine is used for this type of activity.
- **Trench digging:** The trench will be dug using suitable excavator or trenching machinery. The excavated soil will be stored on the other side of the trench to that of the topsoil to prevent mixing. All rock will be removed from the trench prior to the lowering-in operation.
- **Pipe welding:** Pipe steel sections will be welded together to form the pipeline using a motor-driven welding machine by a continuous arc welding process or by manual welding. Non-destructive tests will be performed for each weld.
- **Joint coating**: After the weld has been tested and approved, the exposed steel section will be covered with a protective coating, usually a heat-shrinkable polyethylene sleeve around the pipe. Moreover, any coating fault or void will be repaired.

- **Pipe laying:** the welded pipe will be lowered into the trench by the side boom. Only stone-free material will be used for bedding the pipe sections and, in areas of rocky terrain, sand or sieved backfill material will be placed in the bottom of the trench and on both sides of the pipe for protection purposes.
- **Backfilling and site reinstatement:** following lowering of the pipeline, backfilling will be undertaken, subsoil and then topsoil. The site will then be levelled to original contours and stabilised through reinstatement. All equipment, access roads and crossings will be removed. Eventual land drainage infrastructure, access roads, other networks and facilities disturbed during construction will be reinstated to their former state. If required, the final step will be the establishment of access barriers to prevent trespassing on the ROW at appropriate points.

2. In case of an above ground pipeline:
   The construction steps are the same as for the underground pipeline described above except that instead of the trench digging and backfilling steps, the following will be carried out:

- **Supports:** The supports will be made of light shallow concrete foundations with an anchoring system to maintain the pipeline on the supports while allowing small longitudinal displacement due to thermal radiation.

  The final step is the installation and anchorage of the pipeline on the elevated support though the use of side boom.

3.4.5 Electrical Transmission Line

The transmission line will be buried in an existing corridor already cleared of vegetation. A permanent RoW will be established. Construction activities are similar to those foreseen for the buried condensate export pipeline installation but on a smaller scale:

- **Preparation of the working strip**: Existing topsoil will be removed from the construction areas by suitable earth moving equipment and stockpiled at a designated storage location at a minimum distance from the edge of the excavation. Where present, the topsoil stockpile will be typically no higher than 2 m to prevent degradation of the soil, and it will be kept free from disturbance to reduce the possibility of physical damage and compaction. The working strip will be levelled, using suitable construction equipment (pickup trucks, loaders, dozers, shovel and backhoes), to eliminate large stones, irregularities and other features.
- **Trench digging:** The cable will be laid in a trench. It will be excavated with a suitable excavator or trenching machinery. The excavated soil will be piled adjacent to the topsoil pile, separated to prevent mixing. All rock will be removed from the trench prior to the lowering-in operation.
- **Transmission line cables laying:** the cables will be lowered into the trench with suitable equipment. Only stone-free material will be used for bedding and backfilling, in areas of rocky terrain, sand or sieved backfill material will be placed in the bottom of the trench and on both sides of the cable for protection purposes.
- **Backfilling**: Backfill will be placed over the cable immediately after the cable has been placed in the trench. Backfill material will be compacted in layers. Extreme care will be taken with the initial fill to avoid damage to the cable. After the initial layer of screened material is placed into the trench, the remaining soil and rock mixture will be replaced to complete the backfill. Trenching material not used for backfilling will be removed and disposed of.
- **Reinstatement**: Removed topsoil will be placed back on the working corridor. The original contours of the land will be restored as closely as possible. As part of the restoration process, all equipment, access roads and crossings will be removed. Eventual land drainage infrastructure, access roads, other networks and facilities disturbed during construction will be reinstated to their former state. If required, the final step will be the establishment of access barriers to prevent trespassing on the ROW at appropriate points.

3.4.6 Precommissioning & Commissioning

Pre-commissioning and commissioning of the processing facilities will involve equipment testing, and hydrostatic testing of the vessels and pipework to ensure mechanical integrity.

During these activities, the high-pressure tests on equipment that will contain fluids will be carried out. During this phase, systems and utilities will be brought into operation to ensure they are functioning to design specifications.

3.4.7 Duration and Timing

The LNG Plant construction activities are expected to last about 34 months including pre-commissioning and commissioning. The construction activities will start in the third quarter of 2024 and will be concluded with the start-up of the plant at mid-2027.

The pre-commissioning will last 15 months and will start by the first quarter of 2026.

3.5 Operations & Maintenance Phase

The design life of the LNG Plant is 25 years. Therefore, the operation phase is expected to be the most significant in terms of potential impacts, especially with regard to air and noise emissions, and impacts related to waste management activities. This phase will also include activities such as the movement of vehicles, equipment and personnel, and the storage and handling of fuel and chemicals.

During the operation phase, all project components described in Section 3.3 will be in operation.

Operational issues of major relevance for this phase are equipment operation and unplanned events, including leaks and spills. In addition, pollution control and waste management in relation to maintenance, as well as the impacts on the landscape are also of relevance.

The roads used to access the LNG plant for maintenance will be the same as those used during the construction activities and part of the Sohar port infrastructures distributing all industry plots.

The use of resources and the environmental interference during this phase is described in Section 3.7. The number of personnel foreseen during the operation phase is described in Section 3.8.2.

With regards to maintenance activities, the planned shutdown of the plant is scheduled every 4 years lasting for 21 days. The main activities will be related to corrective or preventive maintenance on all major equipment to ensure their reliability during operation.

3.6 Decommissioning & Abandonment Phase

At the end of the operational lifetime, the LNG site facilities and associated infrastructure will either be extended or decommissioned.

In case of decommissioning, this will take place in the future when the operations are finished (at least after 25 years). At that time, the conditions of the area and legislative requirements are likely to be different from those that currently exist. Consequently, at this stage, a description of typical activities associated with a decommissioning and abandonment phase is provided. It is assumed that a detailed decommissioning and rehabilitation plan will be developed before these activities take place, taking into consideration available technologies and legislation existing at the time.

Decommissioning of the LNG plant, pipelines and transmission lines will involve the removal and reuse/ recycling/ disposal of surface structures and the reinstatement and restoration of the affected sites. The decommissioning of the jetty topsides will include the removal of all the equipment and piping. Activities such as the movement of vehicles, equipment, personnel and supplies, storage and handling of fuels and chemicals, and treatment and disposal of wastes are expected to be similar to those of the construction phase (see Section 3.7 relative to the construction phase).

The number of personnel foreseen during the decommissioning and abandonment of all project components is expected to be similar to that required during construction (see Section 3.8.1).

3.7 Use of Resources and Environmental Interferences

The resource use and environmental interferences per Project phase are described in the following sections.

3.7.1 Land Use

3.7.1.1 Construction phase

All land take required during the construction phase, will be located inside the LNG Plant site as shown in Figure 3-1. The site is likely to include temporary offices, canteen, workshop, parking area, laydown area, and a small warehouse.

Should any additional space be required, an additional laydown area or warehouse will be rented at Sohar Port Free Zone area (SPFZ, see Figure 3-8) or in the vicinity of Sohar Industrial Port.

No additional land take is foreseen at this phase. The condensate export pipeline, feed gas pipeline and transmission line will be located along existing corridors. Accommodation camps already exist.

The solar plant, planned to be constructed in a different plot, is not part of the Project's scope, therefore the land take linked to the solar plant will be evaluated in a separate and dedicated ESIA.

Source: Sohar Port and Freezone, 2023.

Figure 3-8 Sohar Free Zone in relation to nearby areas of development

All material and special construction equipment will be transported and stored in the designated storage areas and warehouse area inside the site or on dedicated area within SPFZ or Sohar Port neighbourhood.

The land use required by the construction activities is reported in Table 3-1.

Table 3-1 Land Use during the Construction Phase

Component	Land Take
LNG Plant Site	Approximately **445,000 m^2** maximum Within reclaimed and levelized land.
LNG Plant construction site	Within the LNG Plant site, no additional land take. With temporary offices, canteen, workshop, laydown area, small warehouse.
Potential Temporary Remote Laydown area (outside LNG Site)	Approximately **200,000 m^2** Potentially remote laydown area or warehouse at SPFZ or in the neighborhood of the Sohar Port (rented).
Accommodation camp	Outside the port - Existing. No additional land take
Condensate export pipeline	Located within the Sohar Port Area, running parallel to existing pipeline corridors. No additional land take.
Transmission line	Located within the Sohar Port Area, running parallel to existing transmission lines. No additional land take.
Feed gas pipeline (AF)	Located within the Sohar Port Area, running parallel to existing pipeline corridors. No additional land take.
Jetty (AF)	Base case 450-500-m long x 4-m wide road
Solar Plant (AF)	Outside the port - planned to be constructed in a different plot at a distance of approximately 30 km from the port as an offset GHG emission solution for the Project

Note: AF designates Associated Facility

Source: MARSA LNG LLC, 2023.

3.7.1.2 Operation phase

The LNG site will occupy an area of approximately 445,000 m^2. No additional land take is foreseen during this phase.

3.7.2 Chemicals

3.7.2.1 Construction, precommissioning and commissioning phase

During the construction, pre-commissioning and commissioning activities, the use of chemicals is not foreseen except for small quantities of lubricant for the heavy equipment or cleaning before equipment assembly.

3.7.2.2 Operation phase

During the operational phase, the use of chemicals for equipment processing is foreseen. The main chemicals will be:

- Methyl diethanolamine (MDEA) with piperazine: used in the AGRU, 43,900 kg will be filled at start-up and used on closed loop, with an annual consumption of 2,300 kg.
- Sodium hypochlorite for potable water sterilization is estimated from 0 to 0.18 L/h.
- Anti-foam is estimated in 0.73 L/h.
- Corrosion inhibitor, used in the water circuit is estimated at 0.33 kg/h.
- Biocide consumption is estimated in 0.18 L/h.
- Caustic soda and sulfuric acid used in the wastewater treatment. Consumption is estimated in 0.11 L/h for the first and 0.06 L/h for the second.
- Lubricant oil and grease in the equipment maintenance.

3.7.3 Fuels

3.7.3.1 Construction, precommissioning and commissioning phase

During the construction activities, heavy equipment and motor engine driven equipment will be fuelled with diesel oil. In addition, portable diesel power generators will be used. Approximately 30,000 litres per day of diesel oil will be used during the LNG Plant construction, precommissioning and commissioning phase.

3.7.3.2 Operation phase

The main fuel to be used during the operation is the fuel gas. The fuel gas users are the AGRU incinerator, the thermal oxidiser for NRU waste stream, and the flares pilots. Fuel gas consumption is estimated in 50 kg/h for the incinerators. The consumption of the flare pilots is not significant. Fuel gas composition is reported in the Table 3-2.

Table 3-2 Fuel Gas Composition

Substance	Composition (% mol)
H_2O	0.7438
Nitrogen	0.6427
Carbon Dioxide	0.4385
Methane	91.3211
Ethane	5.3772
Propane	0.7799
i-Butane	0.0938
n-Butane	0.1045
n-Pentane	0.0765
n-Hexane	0.0000
n-Heptane	0.3951
Benzene	0.0270

Diesel will be also used for the emergency equipment such as the essential diesel generator and fire water pumps; limited quantities will be consumed during the equipment testing.

3.7.4 Energy

3.7.4.1 Construction, precommissioning and commissioning phase

Portable diesel power generators will be used to supply energy during the construction, precommissioning and commissioning works.

3.7.4.2 Operation phase

The power will be provided from the existing grid. Up to 80 MWh will be provided by the transmission line.

3.7.5 Water Supply and Consumption

3.7.5.1 Construction, precommissioning and commissioning phase

The predicted water consumption during the construction, precommissioning and commissioning phase is related to the construction works, for civil use, dust suppression, hydrotest and for personnel use.

The total water supply for potable use during the construction activity is estimated to be about 150 m^3 per day (60 litres/day per person). Potable water will probably be supplied from Majis Industrial Services Company or a third party.

During the commissioning, a quantity of water will be used for hydrotesting activities to ensure the integrity of vessels, tanks and piping by raw water. The LNG Tank will be commissioned with sea water and cleaned afterward using fresh water. The quantities to be used during hydrotesting are reported in Table 3-3.

Table 3-3 Water Consumption During the Hydrotesting

Equipment	Type of Water	Consumption
LNG Tank	Sea water	90,000 m^3
Piping	Fresh water	6,000 m^3

Source: MARSA LNG LLC, 2023.

Water for LNG Tank hydrotesting will be taken directly from the sea. Freshwater for piping hydrotesting will come from Majis Industrial Services Company, which is fed with water from a desalination plant. All hydrotest water will be contained and analysed before disposal.

3.7.5.2 Operation phase

During operation, a water supply will be required for LNG processes, mainly for operating the LNG train, service and wash water system, as well as the firefighting system. Water will also be required for service and civilian use.

The process and potable water will be supplied from Majis Industrial Services Company, which is fed with water from a desalination plant. The selected cooling system (air, instead of water) significantly reduces the project water use and wastewater production.

The process water consumption is estimated of 10 m^3/h during the operational phase and will be provided on an intermittent basis as detailed below.

- 6 m^3/h utility stations (intermittent basis)
- 4 m^3/h for HVAC system (intermittent basis)

Apart from process needs, potable water will be used for personnel usage. The consumption rate has been established on the basis of 120 people on site consuming on average 200 l/day per person.

The expected water consumption is summarised in the Table 3-4 below.

Table 3-4 Water Consumption in the Operational Phase

Type	Consumption
Process water	10 m^3/h (intermittent)
Potable water	200 l/person/day

Source: MARSA LNG LLC, 2023.

3.7.6 Transportation & Traffic

3.7.6.1 Construction, precommissioning and commissioning phase

During the construction, pre-commissioning and commissioning activities, a peak motor transport traffic of 150 vehicles per day is foreseen, mainly related to the movement of the workers (bus, van, pick-up) and heavy equipment (including excavators, roller compactors, breaker/dozers, grader, welding/bending machine, cranes, compressors, trucks).

A number of vessels will be required to deliver equipment, piping and material needed for the plant construction. The vessels will be unloaded using the infrastructures of the Sohar Port and the material transported to the site via trucks.

3.7.6.2 Operation phase

During the operation phase, the estimated traffic will include a limited number of vehicles per day, mainly cars and vans transporting the workers involved in the LNG site operation and a few trucks for transportation of goods and materials.

Vessel traffic will depend on the LNG market request. The following scenarios can be considered as base case:

- LNG Export Carrier: 15 offloading/year (in case of no bunkering demand);
- LNG Bunker Vessel: 1 offloading/day (in case bunkering demand consumes all production).

Consequently, maximum vessel traffic associated to the LNG terminal operation is one vessel per day.

3.7.7 Atmospheric Emissions

3.7.7.1 Construction, precommissioning and commissioning phase

During project construction, precommissioning and commissioning, air emissions will be generated by the following activities:

- Temporary dust emissions from earth movements, excavation, vehicle movements, stockpiles, unpaved surfaces, etc.
- Temporary emissions of exhaust gases into the atmosphere generated by the power generators, construction equipment the two incinerators, the flare systems and the backup generators. However, emissions of the two incinerators, the flare systems and the backup generators will be over very short periods given the transient nature of these operations and negligible during precommissioning and commissioning, compared to yearly emissions during the construction phase. The main produced pollutants will be NOx, CO, SOx and particulate matter.

3.7.7.2 Operation phase

Air emissions generated during operation will mainly be related to gas exhausted from the following equipment:

- AGRU Incinerator: to be used to treat with combustion the acid gas from the AGRU. The AGRU acid gas composition is reported in Table 3-5. The AGRU incinerator characteristic and achievable emissions are reported in Table 3-6..
- NRU Incinerator: to be used to treat with combustion the nitrogen from the NRU. The characteristics and emissions from the NRU incinerator are shown in Table 3-7.
- The flaring system (cold/warm flare(s)): the flaring system is an emergency equipment to be used only in case of plant start-up, malfunctioning or maintenance (equipment or line purging). During the normal operation, only the tips of the warm flares will be active, fuelled will a small stream of fuel gas, this is needed to maintain the flame used to ignite an eventual stream to be burned by the devices. The fuel gas combustion in the tips will generate NOx, CO and negligible concentration of SOx and particulate matter.
- Other equipment that will generate air emissions is the diesel fuelled essential backup generator, which will be present at site; however, it will only used for emergency and periodic testing. The operation of the diesel emergency generator will generate NOx, CO, SOx and particulate matter. In addition, the LNG plant will generate fugitive emission of Volatile Organic Compound (VOC), from the equipment, piping connections, valves and flanges. On the other hand, the Heating medium will operate on continuous basis, and it will be using electrical heater; therefore, no emissions are associated with it. Overall, the main air emissions will be generated by the incinerators.

Table 3-5 AGRU Acid Composition

Substance	Composition (% mol)
H_2O	6.61
Carbon Dioxide	92.91
Methane	0.39
Ethane	0.04
Benzene	0.01
H_2S	0.03

Source: MARSA LNG LLC, 2023.

Table 3-6 AGRU Incinerator Characteristics and Emissions

	Unit	Design Values
Stack height	M	24 (typical)
Acid Gas Flow	Kg/h	2,400 (base case) 6,153 (high CO_2 case)
Fuel Flow	Kg/h	40
Emissions		
NOx	mg/Nm^3	100
Benzene	mg/Nm^3	1
Total particulates	mg/Nm^3	100
SO_2	mg/Nm^3	– -
VOCs	mg/Nm^3	35
H_2S	ppmv	5

Source: MARSA LNG LLC, 2023, BAT assessment report

Table 3-7 NRU Incinerator Characteristics and Emissions

	Unit	Design Values
Stack height	M	24 (typical)
Exhaust Gas Flow	Kg/h	4,300
Fuel Flow	Kg/h	None
Emissions		
NOx	mg/Nm^3	100
Benzene	mg/Nm^3	0
PM_{10}	mg/Nm^3	0
SO_2	mg/Nm^3	0

Note: Since the stream to be oxidized is pure Nitrogen with traces of Methane, no NOX, SOx, PM10 will be emitted.

Source: MARSA LNG LLC, 2023.

3.7.8 GHG Emissions

3.7.8.1 Construction, precommissioning and commissioning phase

During construction, precommissioning and commissioning phase, GHG emissions will be generated by the following activities:

- Operation of vehicles that are expected to be used during construction/commissioning works (i.e., excavators, bulldozers, trucks, and cars);
- Operation of power generators that are expected to be used to supply energy during the construction/commissioning works.

The operation of the abovementioned equipment is expected to consume 30,000 L/day of diesel. Table 3-8 reports a summary of the expected annual GHG emissions during construction phase. Details regarding the methodology applied for the calculations are reported in Appendix D on Climate Change Risk Assessment (CCRA).

Table 3-8 Expected annual GHG emissions during construction phase

Equipment	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2eq [ton/y]
Diesel Generators, Construction Equipment, Heavy Vehicles, Light Vehicles, Admin Offices, Labor Camps	29,833	1.20	0.24	29,932

3.7.8.2 Operation phase

During operation phase, GHG emissions will be generated by the following equipment:

- AGRU Incinerator (Thermal Oxidiser) will be used to treat with combustion the acid gas from the AGRU;
- Flaring system (cold/warm flare), due to continuous flow into the flares;
- NRU incinerator: will be used to treat with combustion the nitrogen from the NRU;

Moreover, GHG emissions will be released due to non-routine flaring during start-up, which is expected to happen six times a year according to the following scheme:

- Start-up of warm section: flaring to last 3 hours;
- Start-up of liquefaction: flaring to last 12 hours;
- Start-up of EFG/NRU: flaring to last 24 hours.

Table 3-9 reports a summary of the gas consumption and associated annual GHG emissions from the abovementioned sources expected during operation phase. Table 3-10 reports the same, yet for the high CO_2 case.

Details regarding the methodology applied for the calculations are reported in Part 2 of Appendix D on Climate Change Risk Assessment (CCRA).

Table 3-9 Fuel gas consumption and expected annual Scope 1 GHG emissions during operational phase (Base Case)

Equipment	Gas consumption [kg/h]	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2e [ton /y]
AGRU Incinerator	Fuel gas: 40	942	0.02	0.00	942
	Acid gas: 2400	19,363	-	-	19,363
Flaring pilot	Flare gas: 13	215	1.60	0.00	260
NRU Incinerator	Exhaust gas: 4300	97.7	0.18	-	103
Base Case Total (without flaring)	-	20,524	0.20	0.00	20,530
Base Case Total (with flaring at start-up)	-	21,557	7.47	0.00	21,766
Base Case Total (with flaring)	-	24,542	28.6	0.01	25,341

Table 3-10 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (High CO_2 Case)

Equipment	Gas consumption [kg/h]	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2e [ton /y]
AGRU Incinerator	Fuel gas: 40	942	0.02	0.00	942
	Acid gas: 6,153	49,642	-	-	49,642
Flaring pilot	Flare gas: 13	215	1.60	0.00	260
NRU Incinerator	Exhaust gas: 4300	97.7	0.18	-	103
High Case Total (without flaring)	-	**50,995**	**0.20**	**0.00**	**51,001**
High Case Total (with flaring at start-up)	-	**52,028**	**7.47**	**0.00**	**52,236**
High Case Total (with flaring)	-	**55,012**	**28.6**	**0.01**	**55,811**

3.7.9 Noise Emissions

3.7.9.1 Construction, precommissioning and commissioning phase

During construction/commissioning activities, noise emissions will be generated by heavy equipment involved in the LNG Plant construction and start up.

The main equipment in use during these activities generating noise are included in Table 3-11. Not all the equipment will be active at the same time, some of them will operate only for short period during the construction activities.

Table 3-11 Typical Noise Power Level for the Equipment

Equipment	Typical Sound Power Level [dBA]
Excavator	100 – 106
Roller compactor	105 – 106
Breaker/dozer	101 – 108
Grader	101 – 108
Welding/bending machine	94
Crane	98
Generator	98
Compressor	110
Truck	107
Pick-up	85
Bus	90

Source: ERM, 2023.

During the pre-commissioning phase, the main foreseen noise sources are compressors and pumps for the vessel and pipeline hydrotesting activities and equipment integrity tests. In particular, for the different pre-commissioning stages, the foreseen equipment and related typical sound power level is reported in the Table 3-12 below.

Table 3-12 Typical sound power level for the equipment foreseen for the pre-commissioning Phase

Equipment	Power Level [dBA]
Engine driven pump (2)	95 – 100
Booster compressors (2)	120 -130 dBA
Feed compressors (2)	120 - 130 dBA

Source: ERM, 2023.

3.7.9.2 Operation phase

During operations, noise emissions will be generated by the equipment installed at LNG Plant, in particular:

- The LNG train (dehydrator, hydrocarbon removal, liquefaction units, heater and cooler).
- Compressors.
- Pumps (water pumps, LNG export/transfer pumps).

The LNG Site will run 24 hours a day, 7 days a week.

All enclosure compartments will have forced ventilation with filtered air or other suitable means, controlled in order to limit the inside temperature to a value compatible with the long-term reliable operation of all the equipment.

Special care will be taken with the acoustic insulation, in order to maintain a sound pressure level (SPL) not exceeding 85 dB(A) measured in any position 1 metre from the equipment located in potentially manned areas and not exceeding 90 dB(A) in unmanned areas.

During flaring activities, the highest noise level is expected during start-up or emergency depressurization. However, as per Project specification, noise level at plant fence will not exceed 115 dB(A) during those off-normal conditions. In continuous mode, the maximum allowable noise is 70 dB(A) at SIPC fence during normal operation, complying with IFC and national standards for industrial areas.

As so, the sound pressure level resulting from the operation of the facility at base load, steady state conditions, including start-up, shut-down, and all other off-normal conditions, will not exceed the regulation limits at any boundary line of the site.

3.7.10 Waste Handling and Disposal

3.7.10.1 Construction, precommissioning and commissioning phase

During construction, precommissioning and commissioning activities, the main types of wastes expected to be produced are listed below:

- Inert construction waste: this includes excavated material, building rubble, and unused construction material generated during the preparation and restoration of the worksites. These wastes pose no risk of pollution but need to be disposed of at a controlled disposal site.
- Domestic waste: the offices and administration buildings associated with the worksites will generate amounts of domestic-type waste (i.e., food waste, paper and packaging etc.). This type of waste will be transported to controlled local waste disposal sites.

- Oily and hazardous waste: there will be waste generated during construction/commissioning that needs special handling and treatment. This will include the oily waste associated with vehicle and heavy equipment maintenance (waste oil, material collected from wastewater interceptors etc.); unused or chemical waste, paints and solvents; any other waste, sludge or debris that is unsuitable for disposal in local-type landfills. Such wastes will be segregated for collection and disposal by specialist contractors at equipped and approved sites.

Table 3-13 provides the detailed list of the waste to be produced during the construction, precommissioning and commissioning phase.

Table 3-13 Hazardous/special waste generated during construction, precommissioning and commissioning

Category	Description
Oils and solvents	Empty containers, oily rags, thinners, solvents, degreasers, hydraulic fluids, lube oils, used oil spill clean-up/absorbent materials and associated contaminated soil, used filters, spent lubricants.
Paint	Primers, paints and empty cans.
Coatings	Used for coating pipe joints or repairing damaged factory applied coatings.
Contaminated ground	Waste sites, old mineral workings.
Batteries	Lead acid.
Welding rods	Depending on the composition of the material.
Shot blast	Depending on the composition of the material.
Florescent lamp	Lamp for building or equipment illumination.
Medical waste	Clinical waste, expired medicines

Source: ERM 2023.

The basic approach to waste management is the incorporation of a hierarchy of five best environmental operating practices, including source reduction, reuse, recycling, treatment and ultimately disposal. Source reduction is the primary focus. Waste generation will primarily be reduced at source through suitable operating practices rather than being managed later. Where waste generation is unavoidable, an attempt will be made to minimise it through the reuse, recycling or recovery of wastes to a practicable extent. Treatment will only be considered after reuse, recovery and recycling options have been completely exhausted. The last option is disposal and this will be confined to designated and approved areas.

Working areas will be kept clean and tidy and any waste that is generated from these areas will be properly collected.

All wastes from work areas and from the Temporary Site Facilities, if any, will be placed in the nearest appropriate covered waste containers. These containers will be kept in good condition and clearly identified and labelled, according to the variety and quantity of the wastes envisaged to be collected.

All hazardous wastes generated during the construction, precommissioning and commissioning activities will be stored in a secure and clearly identified compound for subsequent disposal. Hazardous waste will be securely packaged and labelled, in accordance with legislative requirements, to ensure that the waste can be transported safely by an accredited waste disposal contractor for subsequent disposal in an approved disposal site, without risk to either those handling the waste or the environment. All necessary precautions will be taken during the handling and transport of the waste to the storage area to avoid spillage of any hazardous waste.

Wood, metal and other material with a commercial or recycling value will be properly separated and stored in segregated areas prior to removal. Good practices will be implemented in order to avoid the mixing or contamination of valuable waste, but also to keep this waste in a valuable form, easy to transport and recycled.

Domestic/office waste includes paper, aluminium cans, glass, cartons, kitchen waste etc. Domestic waste may also include certain recyclable material, such as paper, plastics, glass, and printer toner cartridges. Domestic non-hazardous waste produced at the camp as well as the small quantities of hazardous wastes (e.g., fluorescent lamps, detergents, clinical waste, spent lubricants and filters) will be taken off site and disposed at licensed Be'ah landfill facility based on the waste acceptance criteria set by Be'ah.

Oily/greasy water will not be directed into the sewage plant until the oil and grease have been removed.

3.7.10.2 Operation phase

During operation, small quantities of waste will be produced at LNG Site, mainly due to equipment maintenance. Domestic waste will also be generated.

Main waste types produced during operation are reported in Table 3-14.

Table 3-14 Waste Production in the Operational Phase

Type	Description
Liquid Hydrocarbons	AGRU Unit, Effluents treatment system
Exhausted Carbon filter	AGRU Unit
Exhausted or off-spec chemicals	Various Units
Empty containers of chemicals	Various Units
Adsorbents bed	Mercury removal, dehydration Units (to be replaced every 4 years)
Oils and solvents	Maintenance: Empty containers, oily rags, thinners, solvents, degreasers, hydraulic fluids, lube oils, used oil spill clean-up/absorbent materials and associated contaminated soil, used filters, spent lubricants.
Batteries	Lead-acid batteries.
Florescent lamp	Lamp for building or equipment illumination.
Medical waste	Clinical waste, expired medicines

Source: MARSA LNG LLC, 2023.

The types of wastes that will be produced due to the project activities are expected to be the following:

Hazardous waste:

- Solid: the majority of operations producing this category of waste will be managed by Logistics entity since it will be evacuated by trucks to Be'ah landfill facility based on the waste acceptance criteria set by Be'ah or exported abroad if necessary. It includes: oil filters, hydrocarbons, batteries, printer cartridges, medical, chemicals, etc.

Non-Hazardous waste:

- Solid (recyclable or not): idem as solid hazardous waste above. It includes: plastic, carton, metal, wood, tires, furniture, glass, food, etc. It is estimated that one transport of waste per week (5-10 tons trucks) will be needed due to the project activities. This would translate into 300 T/year of waste transported.

Waste storage/segregation area will be composed of two waste segregation areas:

- A Waste shelter: will be of an estimated area of 200 m^2 and ventilated.

  a) The design of the area shall be aligned with REP-230-12-MJ - On-site storage of industrial waste (MECA Guidance note).

  b) The area shall be fenced by wall at human height to prevent from distribution of waste due to wind.

  c) The area shall be enough ventilated.

  For hazardous waste storage, hazardous waste stream is estimated to be composed of: oil filter, batteries, printer cartridge, contaminated soil, hydrocarbons, electric/electronic equipment waste (WEEE), empty hazardous chemical containers, oily/paint/thinner.

- A Waste open storage area will be of an estimated area of 400 m^2.

  The design of the area shall be aligned with REP-230-12-MJ - On-site storage of industrial waste (MECA Guidance note) for non-hazardous waste storage, general and recyclable waste streams: plastic, cardboard, metal, wood, tires, furniture, glass.

All wastes will be placed in the nearest appropriate covered waste containers. These containers will be kept in good condition and clearly identified and labelled, according to the variety and quantity of the wastes envisaged to be collected.

All hazardous wastes will be stored in a secure and clearly identified compound for subsequent disposal. Hazardous waste will be securely packaged and labelled, in accordance with legislative requirements, to ensure that the waste can be transported safely by an accredited waste disposal contractor for subsequent disposal in an approved disposal site, without risk to either those handling the waste or the environment. All necessary precautions will be taken during the handling and transport of the waste to the storage area to avoid spillage of any hazardous waste

During maintenance activities, the main waste expected to be produced are:

- the mole sieves catalyst from the dehydration unit estimated between around 50 tons of wasted catalyst,
- the Mercury Guard Bed catalyst from the Mercury Removal Unit estimated around 20 tons of wasted catalyst.
- Consumable parts will also be replaced (metallic seals, filters coalescers, etc.). Estimated weight would be of few tons only.

3.7.11 Effluents Management

3.7.11.1 Construction, precommissioning and commissioning phase

The wastewater production during the construction, precommissioning and commissioning phase will include sewage and brown water. Wastewater will be collected into a septic tank for later disposal by an authorized company.

Hydrotest water produced during the precommissioning and commissioning phases will be reused in the hydrotesting of different parts of the project. Once Hydrotesting is completed, the water will be contained for analysis. If the water is compliant with relevant standards (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port.

3.7.11.2 Operation phase

The following wastewater streams will be produced during the operation:

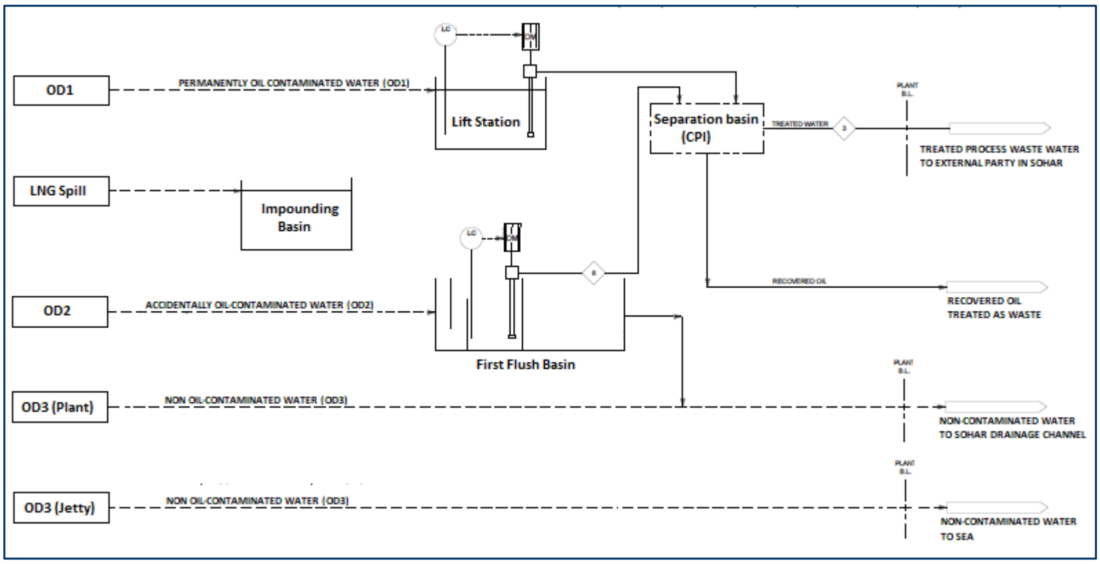
- Streams contaminated by hydrocarbons or chemical, so-called Open Drain 1 (OD1): Liquids collected in drip pans underneath the LNG or gas/condensate process equipment, water draw-off from oil storage tank bottoms (e.g. diesel tank), wastewater from laboratory and analyzer houses, chemical injection skid; all to be collected and disposed as waste.

- Streams potentially (or accidentally) contaminated, so-called Open Drain 2 (OD2): Wastewaters from paved areas in process units, wastewaters collected from non-process facilities, in areas potentially polluted with lube oils and greases from machines (e.g. pumps, transformers, etc.), waste water from bunded areas including roof of oil/condensate storage tanks, chemicals with a limited impact on environment and no adverse effect on oil/water separation, eventual firefighting run-off and storm water first flush from potentially contaminated areas; all to be sent to the external wastewater treatment plant.
- Non-contaminated water, so-called Open Drain 3 (OD3): rain water on unpaved areas; paved area non-contaminated, building and shelters roofs, second flush storm water, water condensed from ambient air in contact with cold process systems, flare area, rainwater from roadways and parking lots; are all to be collected in a dedicated drainage network and discharged to the SIPC reclaimed land drainage channel in compliance with the applicable limits for the plant OD3 or directly to the sea for the jetty OD3.

LNG Plant specificity: where potential LNG leak source can occur, LNG will be collected and diverted to an Impounding Basin within which LNG will vaporize. During normal operation (i.e., not accidental leak situation), the rainwater collected in the impounding basin will be managed as non-contaminated water in compliance with the applicable limits.

Wastewater treatment will be ensured by an external party operating in the Sohar Port. Wastewaters (clean process and drain water) will be gathered at the plant at the storm water basin facility (technically named First Flush Basin in Figure 3-9) from which the first flush is exported to the external treatment unit. Effluents discharges will comply with local legislation and requirements. No wastewater pre-treatment at site is foreseen, only basic separation based on Corrugated Plate Interceptor (CPI).

Below schematic represents the drainage segregation and flow of the LNG plant.



Source: MARSA LNG LLC, 2023.

Figure 3-9 LNG Plant and Jetty drainage scheme

The LNG Plant design will be based on a 10-year return period storm event (46 mm/h) lasting 45 minutes, in which the 20 first minutes' water collected from the potentially polluted water area will be directed to the first flush basin.

In addition, during operation, wastewater will be produced from the process and the sanitary installations located within the LNG Site and treated as described in the construction phase.

3.8 Employment and Labour

3.8.1 Construction Phase

At present, a maximum number of 1,800 workers is expected on site during the peak of activity, working 10 hours per day with overtime of 2 hours for some sections. Work will be implemented on a rotation or shift system basis.

The workforce will consist of at least 30% Omani workers (national) while the rest will be other country nationals (OCN).

Internationally recognised worker conditions, health, safety and environment standards for workers will be applied. These will include full-time doctors and paramedics employed to provide 24-hour medical cover by direct presence or on call.

3.8.2 Operation Phase

At present, the predicted average number of personnel during the entire operation phase is approximately 120 people. The work regime in operation phase will be on a resident basis and a limited number of staff will be on shift basis.

3.9 Health, Safety & Security

Internationally recognised standards for worker Health Safety and Environment will be applied. In addition, the MARSA LNG LLC standard GS EP SAF 521 related to safety specific requirements for LNG onshore liquefaction plants and export will be applied. The different facilities of the Project components (in particular, the jetty head, trestle, LNG plant, LNG storage tank, etc.) are designed with respect to safety and risks as part of an integral approach.

The standard details on the measures that will be put into place by MARSA LNG LLC to manage unplanned events including spills or leaks are detailed below.

3.9.1 Oil Spill Contingency Plan

A dedicated Oil Spill Contingency Plan (OSCP) will be developed according to the MARSA LNG LLC's standard GM EP ENV 092 and aligned with the Oman National Oil Spill Contingency plan and SIPC's requirements on the topic.

The purpose of the OSCP is to minimize both potential environmental damage and the time necessary to remediate polluted sites, including at the topsides and jetty. Such plan shall be specific and consider the layout of the site, the type of substances handled, the operation activities, and shall define potential spill scenarios according to these characteristics.

Each scenario will consider the potential location of the incident, the description of the incident that may result in an oil spill, the type of product spilt, and the estimated quantity spilt.

The analysis of the scenarios will provide an in-depth understanding of the fate of the discharged material, as well as its possible consequences, in particular:

- The behaviour and intrinsic risks of the spilt material (persistence of the hydrocarbons, explosiveness, toxicity);
- The foreseeable movement of the oil (offshore: oil slick drift, onshore: flow towards a target);
- Sensitive areas from a physical, biological, economic, and social standpoint.

Based on the above, the plan will define the strategy to face an eventual spill, equipment, material, roles and responsibility.

3.10 Project Alternatives

3.10.1 Introduction

The Project, at the current status of design, was defined through specific analysis aimed to define the more suitable solution to environmental and social risks and impacts, technical feasibility and financial feasibility criteria.

A key focus of the alternatives analysis was to avoid, minimize and mitigate potential environmental and social impacts.

Further improvement will be evaluated throughout the FEPC process with the environment and social team working closely with the engineering/facilities team.

3.10.2 Location Alternatives

Considering the type of process involved in the Project, the Sohar Port was selected as it is in a favourable location for trade and cargo handling into and out of the Arabian Gulf, and on a major shipping route between Europe and Asia.
In addition, since the Project requires direct access to sea with a jetty to offload LNG bunker barges, the existing reclaimed area in the industrial area of the Sohar Port and the planned jetty structure and mooring means to be constructed by SIPC were taken into consideration for the location of the Project. The Sohar Port has no other reclaiming project or plot available with such space availability and direct access to the sea. Therefore, no other location alternatives were considered.

3.10.3 Technology and Process Alternatives

There are currently several gas pre-treatment technologies and proprietary design options used at various LNG facilities worldwide. The technical evaluation of the processes was considered in the conceptual study undertaken to define the base of design further developed by the FEED contractors. The evaluation considered the production, environment but also operability constraints. The main technical aspects assessed were related to the selection of the cooling medium and the plant power generation source, as well as the refrigerant compressors driver.

The first alternatives were assessed to define the cooling medium: water or air. The marginal additional production brought by a water-cooling medium and the limited difference in terms of power consumption led to the decision to continue the conceptual phase with ambient air as the cooling medium.

Based on the selected cooling medium, three additional power generation schemes were added:

- Full power import;
- Refrigeration power import along with in-plant power generation;
- Self-refrigeration power generation along with power import for the plant needs.

Considering environmental emissions, Oman grid reliability, the lower cost as well as highest production among other concepts, this step led to the selection of the full power import concept.

Basis Design developed by the FEED contractors are assessing different layouts.

The FEED process entailed detailed process design to assess the best available technology options and the most cost-effective approach, and to further minimise environmental and social impacts. Best available techniques (BAT) are those best for preventing or minimizing emissions and impacts on the environment. BAT is often specified for operations and activities in an industrial installation. A BAT assessment has been developed and is presented in Appendix G.

In addition to the LNG Plant itself, a Solar Plant will be developed to compensate on a yearly basis the overall electrical power consumption and the GHG emissions of the LNG Plant. Consequently, the Solar Plant will produce in excess electrical power during the day compared to the LNG Plant consumption. The Solar Plant is not part of this ESIA for the LNG Bunkering Project since a dedicated ESIA will be prepared for this particular development.

3.10.4 No-Project Alternative

The no-project alternative, or zero alternative, implies that the proposed Project would not be executed. Assuming that the LNG Facility would not be developed, the environment would remain in its current state and there would be no negative environmental and social impacts associated with this development.

However, not proceeding with the Project, while taking into consideration all potential environmental and social impacts, runs counter to the country's national interest in economic development due to the projects' potential to attract shipping and investment in the Sultanate of Oman. This economic benefit could be used to improve the health, education and quality of life of the people of Oman. The zero alternative would result in *status quo* conditions and the loss of substantial and long-lasting social and economic benefits for the people of Oman.

Not proceeding with the Project also implies a slower advancement in the global shipping's energy transition. The International Maritime Organization (IMO) has set targets to reduce GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible by 2050, while promoting a just and equitable transition in the context of the 2023 IMO Strategy on Reduction of GHG Emissions from Ships. LNG represents a credible decarbonisation pathway and is the lowest carbon fuel currently available to shipping at scale today, reducing GHG emissions by up to 23% (well-to-wake) compared to Very Low Sulphur Fuel Oil.

4 TERRESTRIAL ENVIRONMENTAL BASELINE

This section outlines the baseline terrestrial (onshore) environment relevant to the Project and highlights sensitive aspects based on the results of several field and desktop investigations carried out by 5OES in 2019 and 2020 and as well as a desk-based update conducted in July – September 2023.

The field and desktop investigations in 2019 and 2020 are detailed in each relevant sections of the terrestrial environmental baseline.

The desktop research of 2023 (hereinafter referred to as the '2023 Desktop Research') consisted of compilation of publicly available information and exchanges with SIPC, seeking to understand potential changes that have occurred in the AoI since the 2019 and 2020 field surveys, particularly related to changes to the air quality baseline, noise baseline and landscape baseline due to:

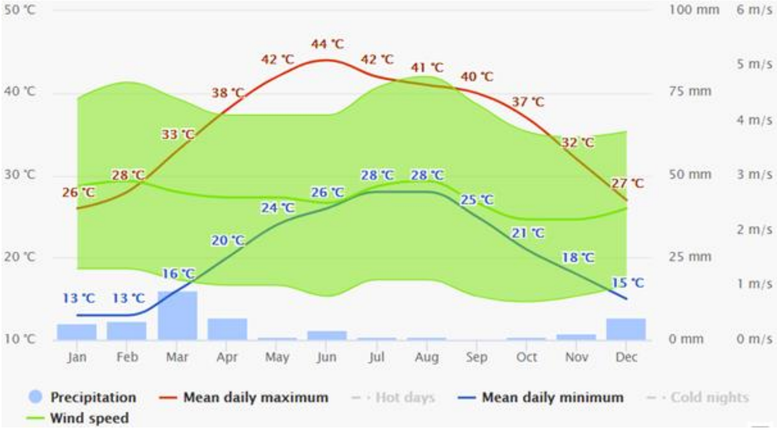
- New industries in construction / operation in the Sohar Industrial Port Area; and
- Changes in the Project layout.

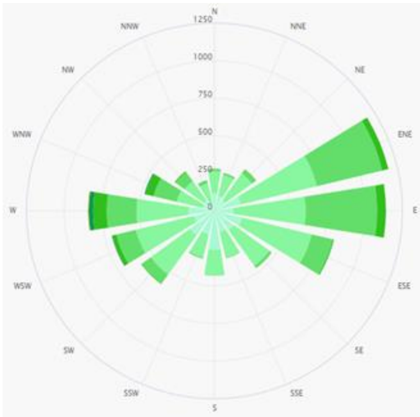
4.1 Physical Environment

4.1.1 Climate and weather

The climate of Oman is typically tropical hyper-arid. In Al Batinah two distinct seasons prevail namely, winter (November to April), and summer (May to October), affected by various meteorological phenomena. Typical weather and climatic conditions in Sohar are illustrated in Figure 4-1.

The area has a mean annual rainfall of 77 mm. Highest monthly rainfall typically falls in March (15 mm), followed by April (7 mm) and December (7 mm). Summer (April - September) and winter (October- March) temperatures range from 20- 44 ˚C and 13-28 ˚C respectively (Meteoblue, 2019). Meteoblue (2019) indicates that wind speeds range from 0.7 -4.8 m/s and are typically highest during the winter months February (4.7 m/s), during 'shamal' wind events, and August (4.8 m/s). Wind direction is mainly from the east-north east, and east. NCSI (2019) states that mean annual humidity is 56.8%. Average and maximum humidity and temperature measured at the Project site on 16-17 April 2019 was 50.63 and 72.17 % and 33 and 42 ˚C respectively.





Source: Meteoblue, 2019

Note: Based on 30 years of hourly weather data at 24.35°N 56.71°E.

Figure 4-1 Mean monthly: temperature, rainfall, and wind speed (top) and wind direction (bottom)

4.1.1.1 Storm Surges and Cyclone Events

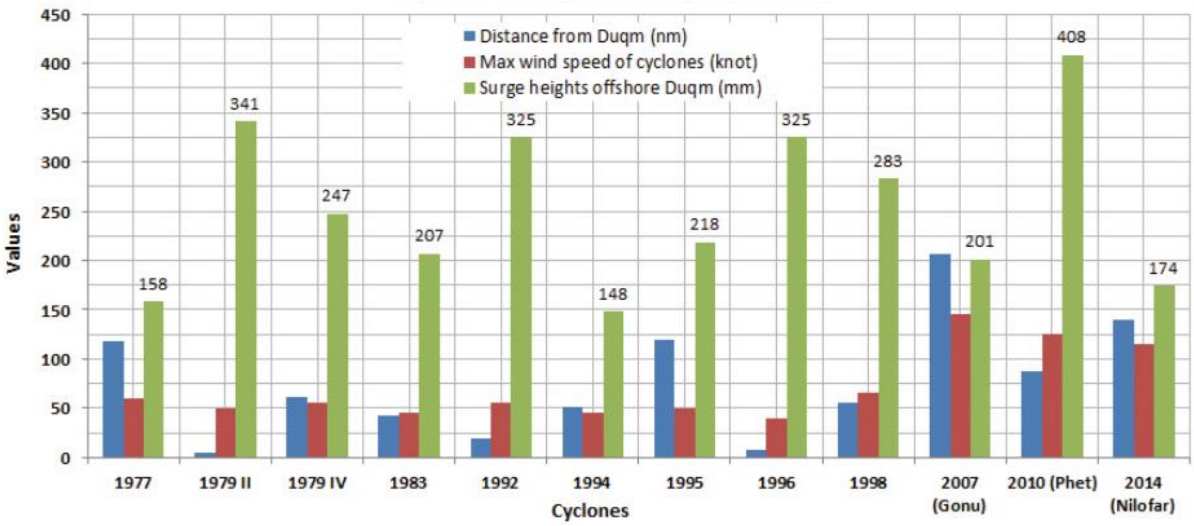
Water levels in Sohar Port and the surrounding area are governed by a combination of tide and storm surge due to low atmospheric pressure (i.e., cyclones) and strong winds.

Sarker (2017) describes the effect of twelve cyclones in relation to storm surge along the Omani coastline with a focus on Duqm, approximately 500 km to the south of Sohar. Maximum wave height and periods range 0.94- 5.45 m and 7.5- 15 s respectively (Table 4-1). Modelled storm surge is shown in Figure 4-2 and was highest (i.e., ~1.0m) during Cyclone Phet in 2010 and lowest (0.158 m) during the 1977 Cyclone (Sarker, 2017).

Wave conditions offshore Duqm	
Max significant wave heights, Hm0 (m)	Peak wave period, Tp (s)
1.54	10.2
3.37	10.1
1.93	10.8
0.94	8.2
3.13	10.4
1.22	8.4
1.13	7.5
2.60	7.6
2.91	8.4
3.11	15.0
5.45	14.1
3.40	14.1

Source: Saker, 2017.

Table 4-1 Wave conditions generated by cyclones offshore of Duqm

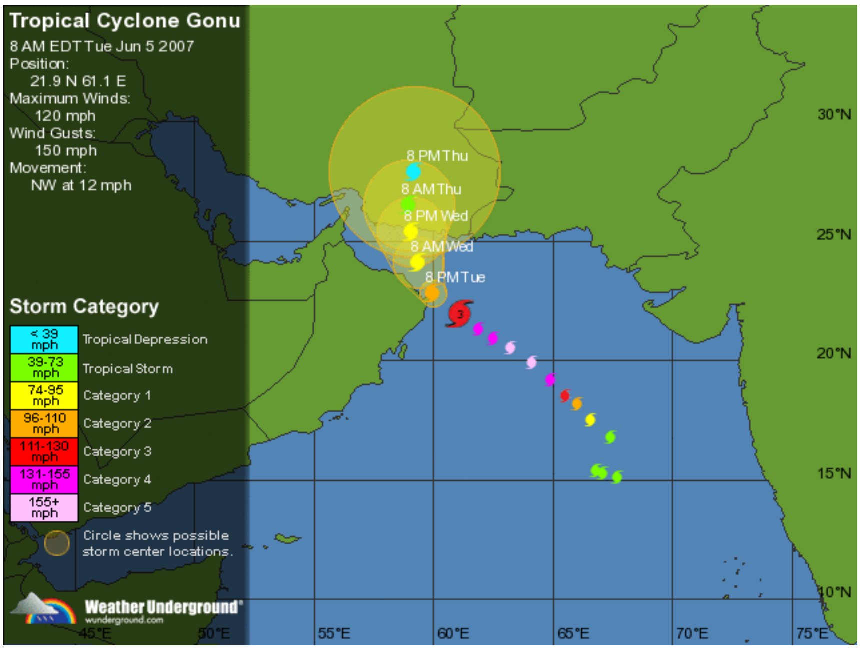


Source: Saker, 2017.

Figure 4-2 Modelled cyclone surge along Duqm coastline

Occasionally (especially during summer), severe storms give rise to short-lived high intensity rainfall which generate large wadi flows and can cause extensive flooding. The most extreme rainfalls are associated with tropical cyclones, which rarely move northward from the Arabian Sea into the Sea of Oman. Tropical cyclones occurring in the Northern Indian Ocean/Arabian Sea form primarily in the monsoon transitional seasons of spring and autumn because it is only during these periods that the monsoon trough is located sufficiently far over the open water of the North Indian Ocean to develop into mature cyclones before they make landfall (Lee et al., 1989).

In the last fifteen years, three major cyclones have been recorded to have impacted the northern coast of Oman (Figure 4-3). The first was Cyclone Gonu (2007) which was one of the strongest tropical cyclones on record in the Arabian Sea. Cyclone Gonu developed sustained winds reaching 240 km/h. Heavy rainfall was recorded near the eastern coastline, reaching up to 610 mm which caused extensive flooding and significant damage to infrastructure and resulted in around 100 lives lost. The cyclone track running parallel to the shore resulted in coastal damage due to storm surge and wind generated waves and lead to the temporary closure of Sohar Port.



Source: https://reliefweb.int/report/oman/oman-alert-cyclone-gonu-approaches; Last accessed: 26.01.2019.

Figure 4-3 Tropical Cyclone GunoGonu (June 2007)

Wilson (2008) described the storm surge during Cyclone Gonu (6 - 9 June 2007) which increased tides by around 35 cm (Figure 4-4) at Wudam Naval Base (~100km south of the Project site) and that the Sohar industrial port has a 100 year storm surge design allowance of 0.4m4 m (assuming a sea level rise 0.5m). Storm surge design in the Gulf of Oman typically varies 0.2 – 0.5m, which indicates that there is uncertainty in the statistics associated with non-cyclonic storm frequencies and intensities in the region (Wilson, 2008).

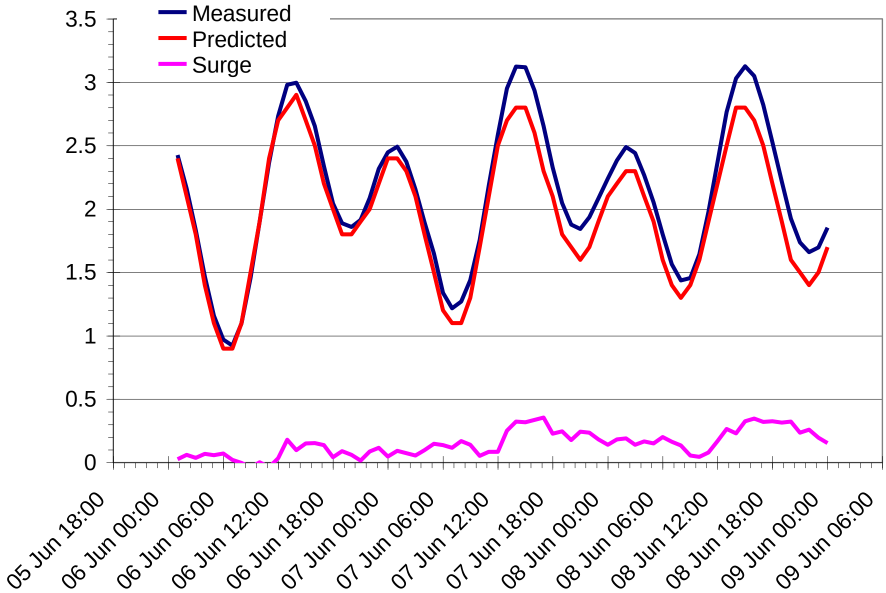
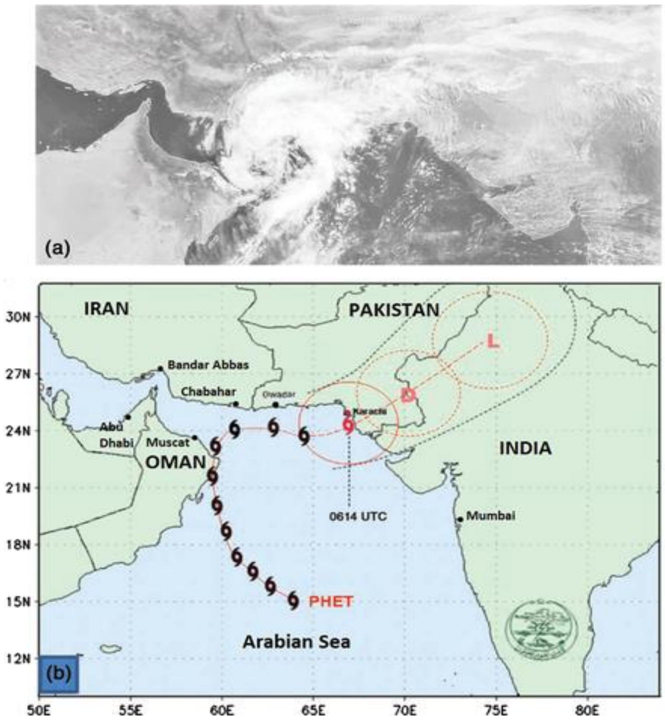


Figure 4-4 Predicted (red line) and measured (blue line) tidal height at Wudam Naval Base during the passage of cyclone Gonu

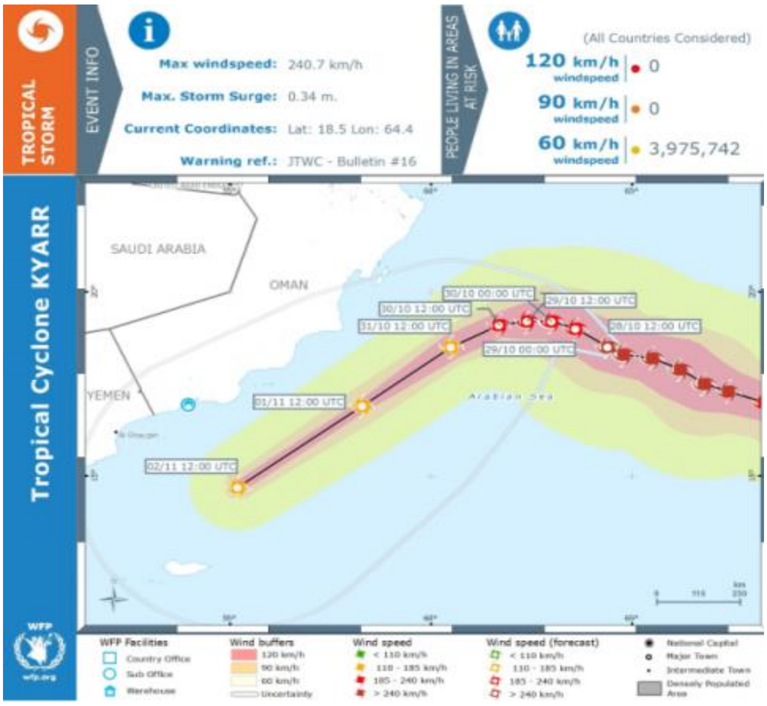
In June of 2010, Cyclone Phet reached the Sea of Oman which caused heavy rain over the northern region of Oman (Figure 4-5). The cyclone started as a category 4 cyclone which weakened to a category 3 as it moved towards the Sultanate. The intensity of the cyclone and the vulnerability of the North of Oman's heavily populated cities caused 47 fatalities and damage to infrastructure. (Rahimi et al. 2019).



Source: [http://www.pmd.gov.pk/Tcyclone - video/admin/Track - add.php](http://www.pmd.gov.pk/Tcyclone-video/admin/Track-add.php). Last accessed: 26.01.2020.

Figure 4-5 Tropical Cyclone Phet (June 2011)

During late October of 2019, Cyclone Kyarr, a category 4 cyclone, made its way across the Arabian Sea (Figure 4-6). The cyclone weakened to a category 1 towards the southern coast of Oman and generated a combination of high tides, storm surges and high waves causing coastal flooding in the northern parts of Oman including Sohar Port and Majis village.



Source: https://reliefweb.int/map/oman/tropical-cyclone-kyarr-warning-n16-28-oct-2019. Last accessed: 26.01.2019.

Figure 4-6 Tropical Cyclone Kyarr (October 2019)

Impacts to nearby residential areas and fishing communities in Majis was observed during the initial stakeholder engagement process (Figure 4-7). The Figure shows beach sediment being deposited to what was initially blacktopped roads serving residential fishing communities. No severe damage to infrastructure was observed during the site visit immediately following the event.

Overall, despite infrequent cyclone events in Northern Oman, the vulnerability of coastal cities and sensitivity of the project to impacts related to harsh weather conditions are evident.

Source: Stakeholder Engagement in Sohar, October 2019.

Figure 4-7 Observed Impact to coastal residential housing caused by Storm Surges

Determining flood risk during this period of climate change requires particular attention. Storm drainage networks are typically designed to the Oman Highway Design Manual (2000) that provides the basis for design with respect to rainfall intensity, duration and frequency curves, which has been critically reviewed by Kotoub (2004) for JICA. The curves are based on an analysis of all available historic data in all parts of Oman. However, the basic underlying statistical distribution of rainfall intensity is likely changing as the climate changes so the power of the historic rainfall dataset to predict rainfall intensity distribution in the future is reduced. When designing flood protection reference should be made to the National Climate Change Mitigation and Adaption Study (2019) as well as the Oman National Spatial Strategy Planning Standards now they have been approved by the Cabinet of Ministers (2020).

4.1.1.2 Climate Change

Temperatures in the Middle East are starting to show evidence of being affected by climate change. The annual records of temperature during the period between 1900 and 1996 show minimal change for the Middle Eastern Region, but a 0.7^{0}C increase for central Asia (IPCC, 2007a). Climate models for the Middle East have projected a regional temperature increase by 1-2 ^{0}C by 2030-2050 with peak temperatures during the winter in the northeast and summer in the southwest. The southern part of the Arabian Peninsula is expected to experience a slight increase in precipitation during the summer as well as an overall regional increase in the winter months.

An assessment of the climate change hazards at the Project location and surroundings (both acute and chronic) including: extreme hot temperatures, flooding (extreme rainfall and coastal flooding), extreme winds (tropical cyclones), and wildfires is provided in Appendix D – CCRA of this ESIA.

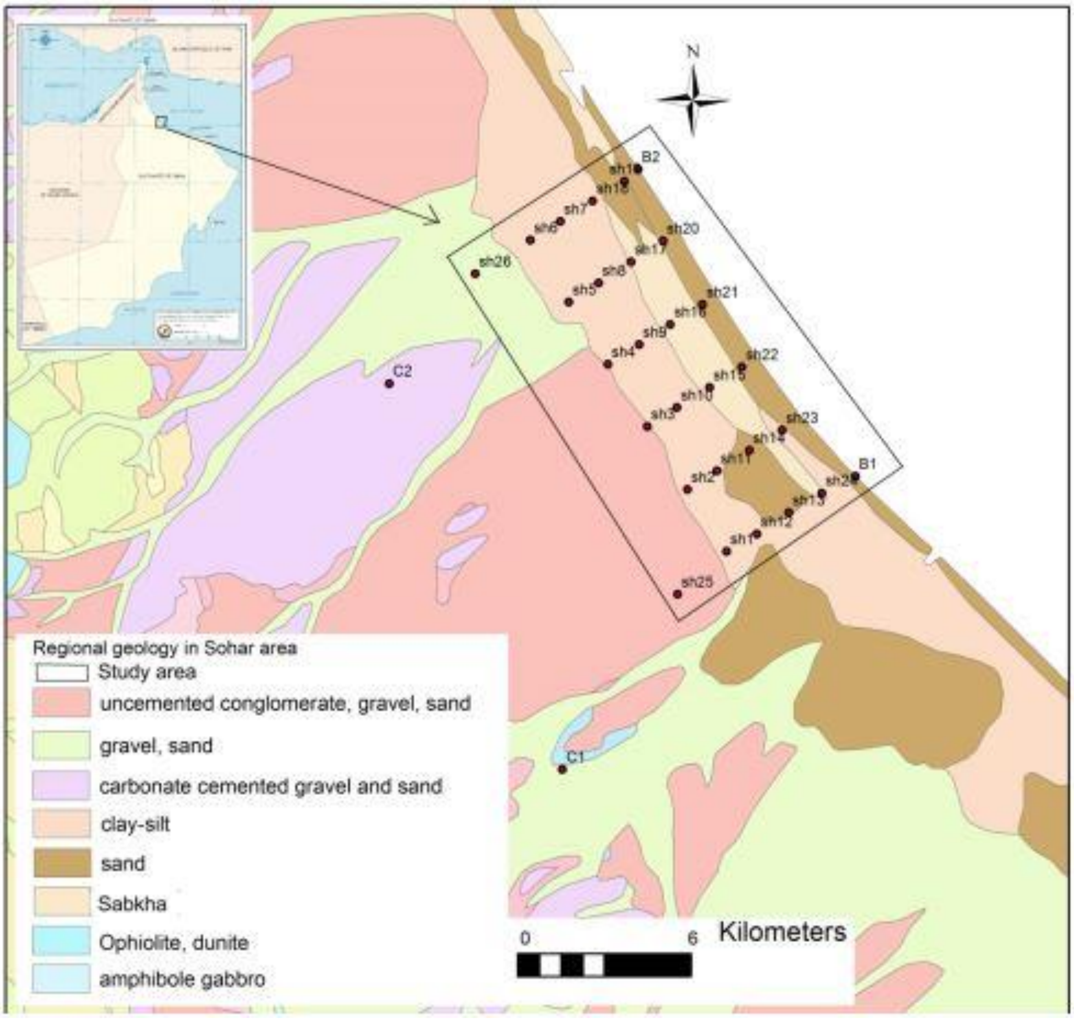
Oman has become a member of the National Strategy for Adaptation and Mitigation to Climate Change 2020-2040 to outline the nation’s long-term vision on climate change. The purpose of the country’s involvement in the strategy is to inform future policy dialogues by laying out clear strategic actions on adaptation and mitigation to ensure low emissions and climate resilience growth is promoted.

4.1.2 Soil Quality

The Project will be located on existing reclaimed land.

The material for the reclaimed land was sourced from capital dredging in the Sohar Port basin. While no soil quality survey has been carried out for the reclaimed land (only geotechnical parameters have been analysed to date by SIPC), soil quality can be inferred from the source areas to provide context. Al-Jabri et al. (2019) report that the minerology of these soils typically contain heavy metals such as Aluminium (Al), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), Lead (Pb), Vanadium (V) and Zinc (Zn) (See Figure 4-8 and Table 4-2). Soils are also predominantly characterised by sabkha, clay, and sand with low organic content.

While Oman has no national soil quality standards, mean concentrations in comparison to international standards for industrial and agricultural soil quality showed that overall concentrations of heavy metals are typically low with the exception of Ni and Cd. High concentrations of Ni and Cd are attributed to weathering of ophiolite rock sequences (in the catchment of SIPC) which have a natural abundance of the minerals.



Source: Jabri et al, 2019

Note: (Sh refers to samples collected from industrial and residential areas, C refers to Control Samples, and B refers to Samples collected in the beach.

Figure 4-8 Geological Map with Sampling Locations in Sohar Industrial Port

Table 4-2 Summary of Heavy Metal Concentrations and international limits of soil heavy metals in the Port

Parameter	Al	Cd	Cr	Cu	Fe	Mn	Mo	Ni	Pb	V	Zn
Minimum	5339	1.7	52	9	11629	239	0.5	256.7	0.7	17	24
Maximum	10399	2.0	103	99	15289	378	1.4	569	8.0	33	405
Mean	8343 ± 1333	1.8 ± 0.1	70 ± 13	30 ± 18	13068 ± 939	339 ± 35	0.8 ± 0.2	397 ± 66	2.2 ± 1.4	25 ±3	56 ± 68
Dutch soil Guidelines	-	12	380	190	-	-	200	210	530	-	720
Chinese Guidelines	-	0.3	200	100				50	300		250
Canada Guidelines		22	87	91	-	-	-	50	600	-	360
EURs	-	3.0	-	140	-	-	-	75	-	300	300
Germany	-	1.0	100	100	-	-	5.0	60	100	50	300

Source: Jabri et. al, 2019.

4.1.3 Groundwater

Depth to groundwater in the alluvial aquifer is shallow in the Northern Al Batinah Region. The thickness of the Quaternary aged alluvium range between 8m and over 300m (ICBA, 2012). Rural water supply, primarily used for agricultural irrigation, is provided by groundwater well abstraction.

Groundwater in Sohar is likely to be 10m below ground level (ICBA, 2012). Investigations carried out by the Ministry of Regional Municipalities and Water Resources (MRMWR) and its predecessors the Ministry of Water Resources (MWR) and the Public Authority of Water Resources (PAWR) have demonstrated that the groundwater resources of the Northern Al Batinah region have been over-exploited, leading to saline intrusion in the coastal strip.

4.1.4 Surface drainage

An investigation conducted within the Sohar industrial zone by 5OES in 2010 (supported by recent investigations by 5OES in 2019) found that the natural wadi channels do not significantly vary, and flow is generally in the north-west direction. The site is flat, and the soil along the Batinah Coast in Sohar is comprised of gravels, incised by active wadi channels with fine alluvium deposits with relatively low porosity in places causing them to be more susceptible to flash flooding. Typically, alluvium deposits in wadi channels will allow surface water to dissipate at a faster rate.

The coastal zone is made up of sand and gravel plains covered by finer sediments with lower porosity. Wadi Suq and Wadi Fizh make up the two main wadi systems in the Sohar Port region. These wadis carry high volumes of water during rainfall events. As a result, the natural storm water drainage system in the Sohar Free Zone has been modified to divert storm water flow to the north and south of Sohar Port.

4.1.5 Air Quality

4.1.5.1 Summary of EA Annual data (Dust & Gases)

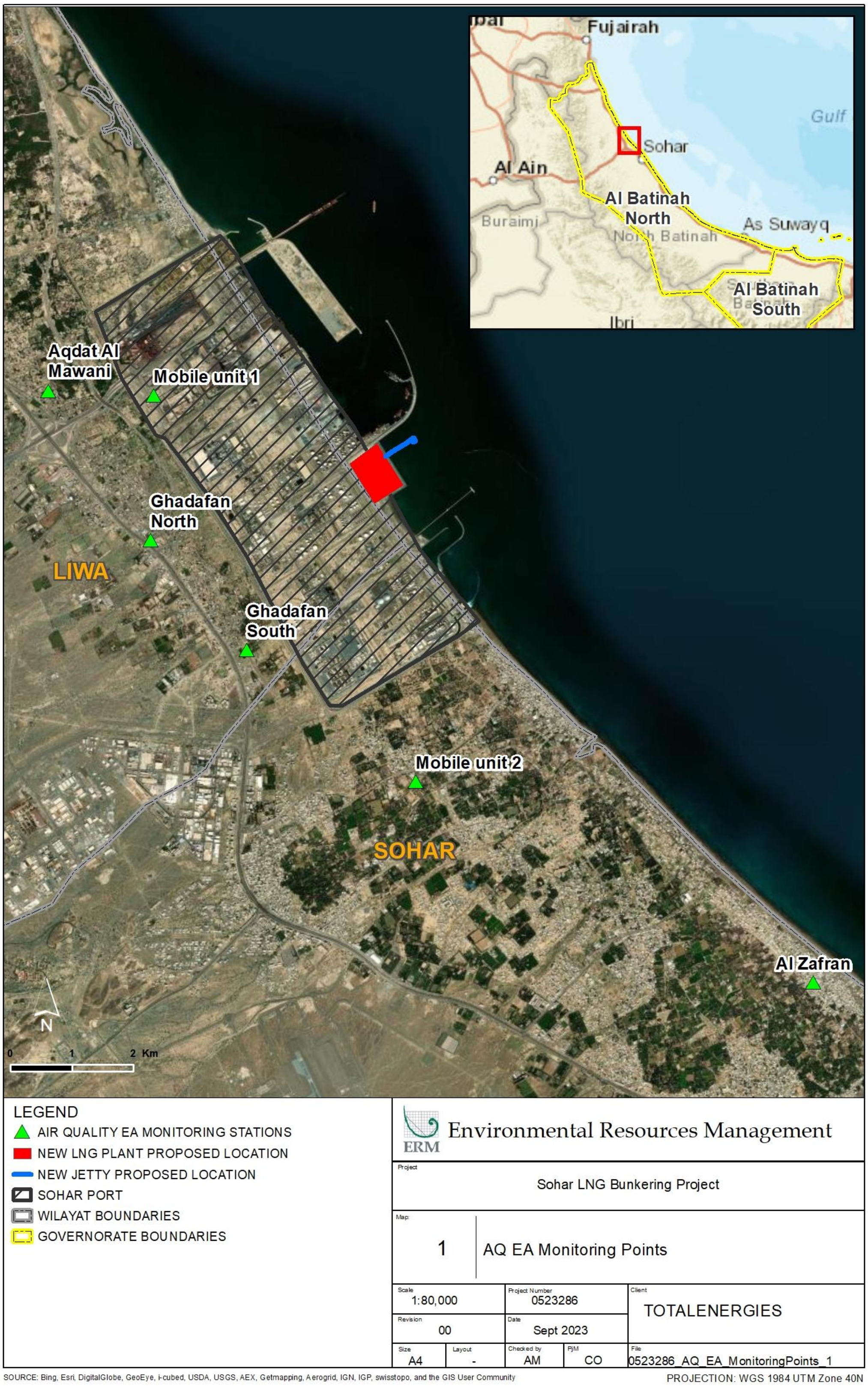
Ambient air quality has been monitored on a continuous basis through a network of six ambient air quality monitoring stations (AAQMS) located near receptors within the Sohar area, owned by EA and operated by Sohar Port. The location of the six monitoring stations and the information related to them are shown in Figure 4-9 and Table 4-3 respectively.

Monitored pollutants include Hydrogen Sulphide (H_2S), Carbon Monoxide (CO), Ammonia (NH_3), Nitrogen Dioxide (NO_2), Ozone (O_3), dust ($PM_{2.5}$, PM_{10}), Sulphur dioxide (SO_2) and nonmethane hydrocarbons (NMHC). The most recent data available, i.e. 2019 to 2021, has been used to describe the air quality in the Project area.

Table 4-3 Description of EA monitoring stations

Monitoring Station	Type	Longitude WGS 84 UTM 40 N	Latitude WGS 84 UTM 40 N	Monitored Parameters
Mobile unit 1	Mobile station	458,835 m E	2,709,818 m N	H_2S, CO, NH_3, NO_2, O_3, $PM_{2.5}$, PM_{10}, SO_2, NMHC
Mobile unit 2	Mobile station	463,097 m E	2,703,388 m N	
Al Zafran	Permanent station	469,600 m E	2,700,241 m N	
Aqdat Al Mawani'a	Permanent station	457,133 m E	2,709,750 m N	
Ghadafan North	Permanent station	458,968 m E	2,707,210 m N	
Ghadafan South	Permanent station	460,364 m E	2,705,613 m N	

Source: Data provided by Ministry of Environment and Climate Affairs (2023) from SOHAR Port and Freezone AQMN Data.



Source: ERM elaboration, 2023.

Figure 4-9 Location of EA monitoring stations

Table 4-4 reports the summary statistics provided by EA (2023) from SOHAR Port and Freezone AQMN Data, computed from pollutant concentrations measured at the six monitoring stations from 2019 to 2021 on the short-term average periods. The statistics have been compared against the limits stipulated in MD41/2017 Oman Regulation and the corresponding limits set by IFC *Environmental, Health, and Safety Guidelines for Air Emissions and Ambient Air Quality* published on 2007, which in turn refers to the WHO Air Quality Guidelines[10]. WHO standards include guideline values and interim targets levels. The latter, in excess of the guideline values, have been set by WHO in recognition of the need for a staged approach to achieving the recommended guidelines.

All the summary statistics were found to be below the national limits for the short-term. Pollutant concentrations have generally been maintained in the same order of magnitude from 2019 to 2021.

The analysis of the impact on the long-term has been performed for NO_2, PM_{10} and SO_2 for a comparison with the IFC Guideline and it is presented in Table 4-5. The results show that PM10 annual concentration is above the IFC guidelines, this high value can be partially attributed to the natural environment (desertic area).

[10] WHO Air Quality Guidelines are available at http://www.who.int/en

Table 4-4 Annual summary concentration statistics of priority pollutants monitored at the EA monitoring stations for the short-term (2019-2021)

Parameter	Averaging Period	Annual Concentration Statistic 2019 (µg/m³)	Annual Concentration Statistic 2020 (µg/m³)	Annual Concentration Statistic 2021 (µg/m³)	MD41/2017 Limit		IFC air quality limits	
					µg/m³	Above Limit	µg/m³	Above Limit
H_2S	1hr	4.39	-	-	30	**NO**	-	-
CO	1hr	290	296	292	30,000	**NO**	-	-
	8hr	230	-	-	10,000	**NO**	-	-
NH_3	24hr	8.11	-	-	200	**NO**	-	-
NO_2	1hr	24.85	18.44	20.62	250	**NO**	200	**NO**
	24hr	21.42	-	-	130	**NO**	-	-
O_3	8hr	61.76	69.91	47.97	120	**NO**	160 (Interim target 1) 100 (guideline)	**NO**
$PM_{2.5}$	24hr	36.44	-	-	65	**NO**	75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (Guideline)	**NO**
PM_{10}	24hr	134.30	193.32	134.30	150	**NO**	150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (Guideline)	**NO**
SO_2	1hr	12.86	17.52	13.80	350	**NO**	-	-
	24hr	8.42	-	-	150	**NO**	125 (Interim target-1) 50 (Interim target-2) 20 (Guideline)	**NO**
NMHC	3hr	169.54	164.25	151.47	160	**NO**	-	**NO**

Source: Data provided by EA (2023) from SOHAR Port and Freezone AQMN Data.

Table 4-5 Annual summary concentration statistics of priority pollutants monitored at the EA monitoring stations for the long-term (2019-2021).

Parameter	Annual Concentration Statistic 2019 (µg/m^3)	Annual Concentration Statistic 2020 (µg/m^3)	Annual Concentration Statistic 2021 (µg/m^3)	IFC air quality limits	
				µg/m^3	Above Limit
NO_2	24.85	18.44	20.62	40	**NO**
PM_{10}	134.30	193.32	134.30	70 (Interim target 1) 50 (Interim target 2) 30 (Interim target 3) 20 (Guideline)	**YES**
SO_2	12.86	17.52	13.80	20 (for the protection of vegetation)	**NO**

Source: Data provided by EA (2023) from SOHAR Port and Freezone AQMN Data.

4.1.5.2 24-Hour Ambient Air Quality (Dust & Gases)

Ambient air quality was also evaluated in a baseline study conducted during 17th – 18th April 2019 by 5OES. Measurements were done using an Aeroqual AQM65 over a 24-hour period at Majis location, shown in Figure 4-10 and located at 462,373 m E and 2,708,128 m N (Coordinate system: WGS 84 UTM 40 N).

Measured parameters included priority pollutants such as Nitrogen Dioxide (NO_2), Oxides of Nitrogen (NO) Sulphur dioxide (SO_2), Carbon Monoxide (CO), Ozone (O_3), and dust ($PM_{2.5}$, PM_{10}).

All the computed statistics are well below the Oman air quality standard (MD 41/2017) and IFC limits, as shown in Table 4-6.

Table 4-6 Concentrations of priority pollutants over 24 hours (17th – 18th April 2019)

Parameter	Averaging Period	Monitored concentration (µg/m³)	MD41/2017 Limit		IFC air quality limits	
			µg/m³	Above Limit	µg/m³	Above Limit
$PM_{2.5}$	24hr	21.0	65	**NO**	75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (Guideline)	**NO**
PM_{10}	24hr	64.7	150	**NO**	150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (Guideline)	**NO**
NO_2	1hr *	36.6	250	**NO**	200	**NO**
	24hr	33.7	130	**NO**	-	-
SO_2	1hr *	18.2	350	**NO**	-	-
	24hr	16.3	150	**NO**	125 (Interim target-1) 50 (Interim target-2) 20 (Guideline)	**NO**
CO	1hr *	0.3	30,000	**NO**	-	-
	8hr	236.5	10,000	**NO**	-	-
NO	24hr	13.4	-	**-**	-	-
Ozone (O_3)	8hr	32.7	120	**NO**	160 (Interim target 1) 100 (guideline)	**NO**

** Maximum hourly recorded value over the 24-hour period.*

4.1.5.3 24-Hour Ambient Air Quality (Dust)

Ambient dust levels were also measured by 5OES continuously between 17th July 2018 and 31st March 2019 during the construction phase of a reclamation project site within SIPC. Monitoring of both $PM_{2.5}$ and PM_{10} was conducted on a continuous basis at a single location in Majis, as shown in Figure 4-10. The maximum $PM_{2.5}$ and PM_{10} daily averages registered during the monitoring period, shown in Table 4-7 and Figure 4-10, are below MD41/2017 and IFC limits.

Table 4-7 Maximum 24-hour average of $PM_{2.5}$ and PM_{10} at Majis station, 17th July 2018 - 31st March 2019

Parameter	Averaging Period	Monitored Concentration (µg/m³)	MD41/2017 Limit		IFC air quality limits	
			µg/m³	Above Limit	µg/m³	Above Limit
$PM_{2.5}$	24hr	49	65	**NO**	75 (Interim target 1) 50 (Interim target 2) 37.5 (Interim target 3) 25 (Guideline)	**NO**
PM_{10}	24hr	88	150	**NO**	150 (Interim target 1) 100 (Interim target 2) 75 (Interim target 3) 50 (Guideline)	**NO**

Source: 5OES, 2023.

Figure 4-10 Location of Dust Monitoring in Majis site

Meteorological parameters (i.e., Relative Humidity, Temperature, Wind Speed, and Wind Direction) were also monitored (Figure 4-11 - Figure 4-14) at the same location in order to have an understanding of PM levels over time. The formation and development of weather events affects the diffusion, accumulation, and transport of air pollutants, causing considerable changes in ambient air quality.

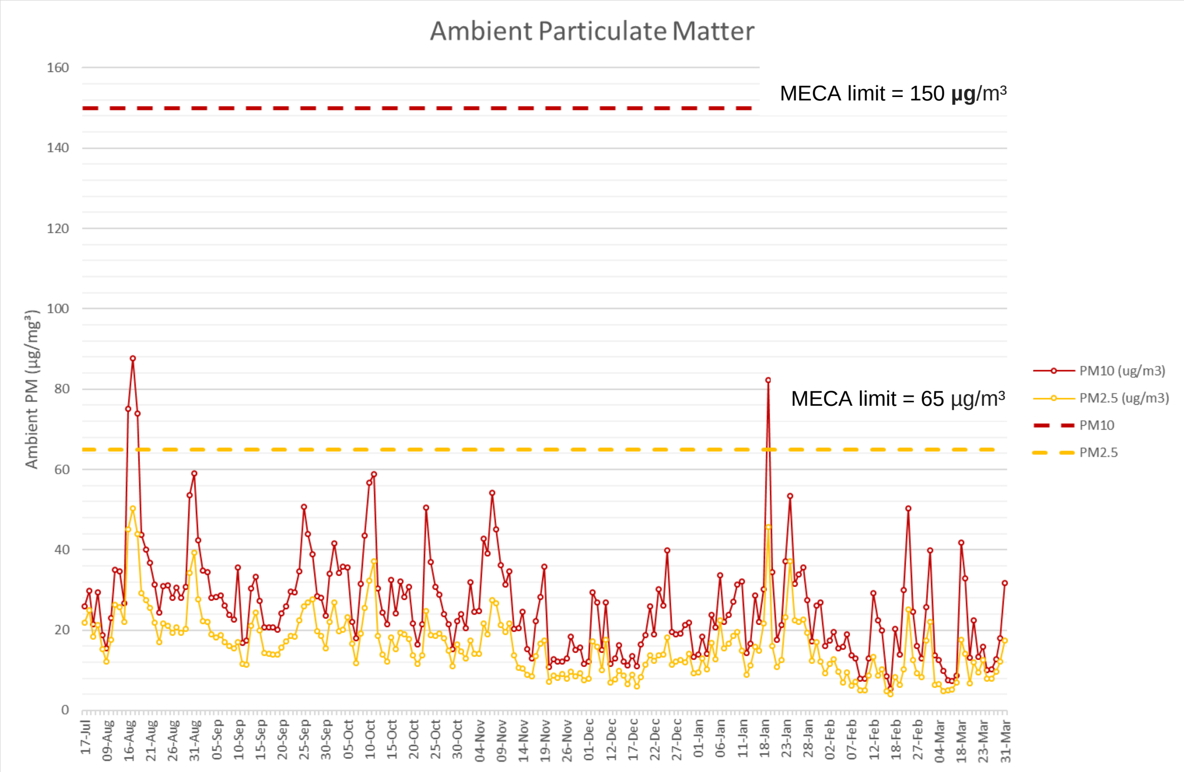


Figure 4-11 Continuous ambient particulate levels from July 2018 to March 2019

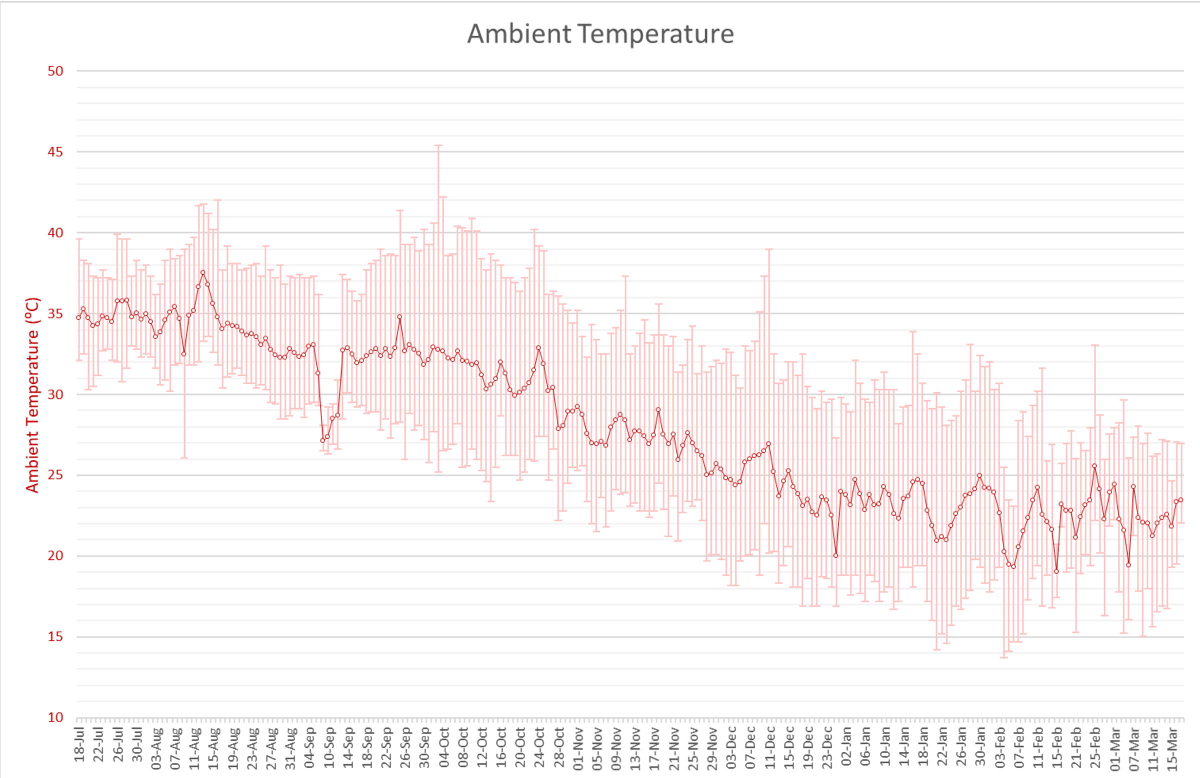


Figure 4-12 Temperature Data from July 2018 to March 2019

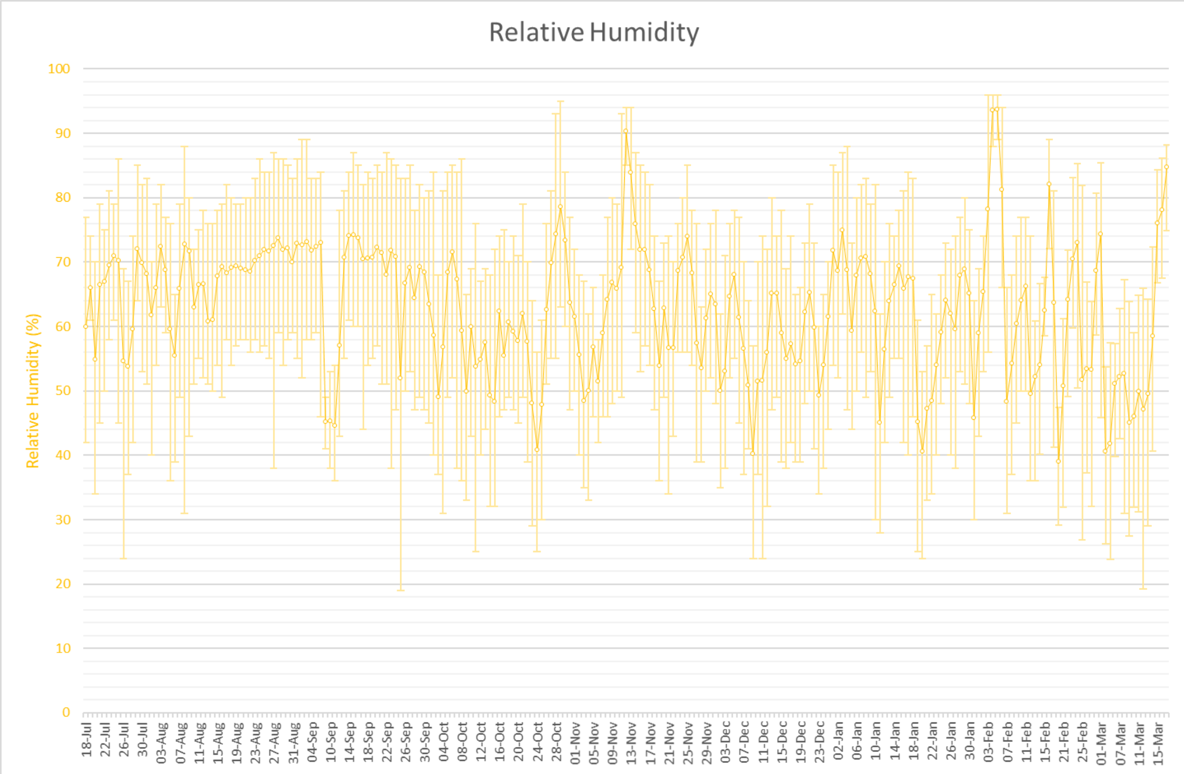


Figure 4-13 Relative Humidity levels from July 2018 to March 2019

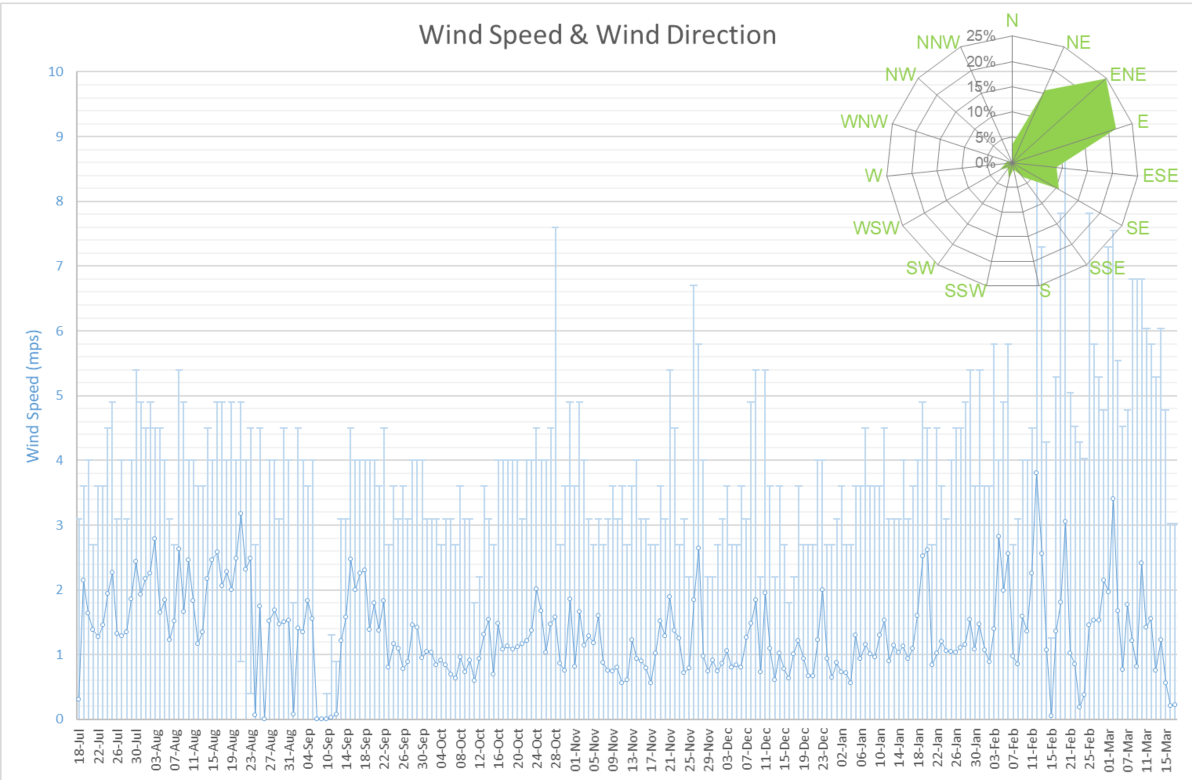


Figure 4-14 Wind speed and wind direction July 2018 to March 2019

4.1.6 Noise

The understanding of the existing baseline noise levels at potentially affected receptors is a key aspect of the noise assessment generated by Project activities. The baseline environment can be defined as the conditions that would prevail in the absence of the Project; it is intended to describe the status of the acoustic climate in the area surrounding the Project site, setting the scene for the assessment of the potential impacts created by the Project during its development phases.

Two noise monitoring surveys were performed to monitor the existing background noise levels at receptors identified in the surroundings of the Project site, one in December 2019 and one in March 2020. The following sections describe the monitoring site locations, the applied methodology and instrumentation, and the monitoring results.

As part of the desktop research of 2023, a review of new industries in construction / operation phase in the Sohar Industrial Port Area and engagement with SIPC were carried out to understand if there were any relevant changes to the noise levels of the baseline environment measured in 2019 and 2020.

Based on desktop research conducted in 2023, the following represents a list of new developments currently planned, under construction or in operations in the Sohar Port Industrial Area or Freezone since 2020:

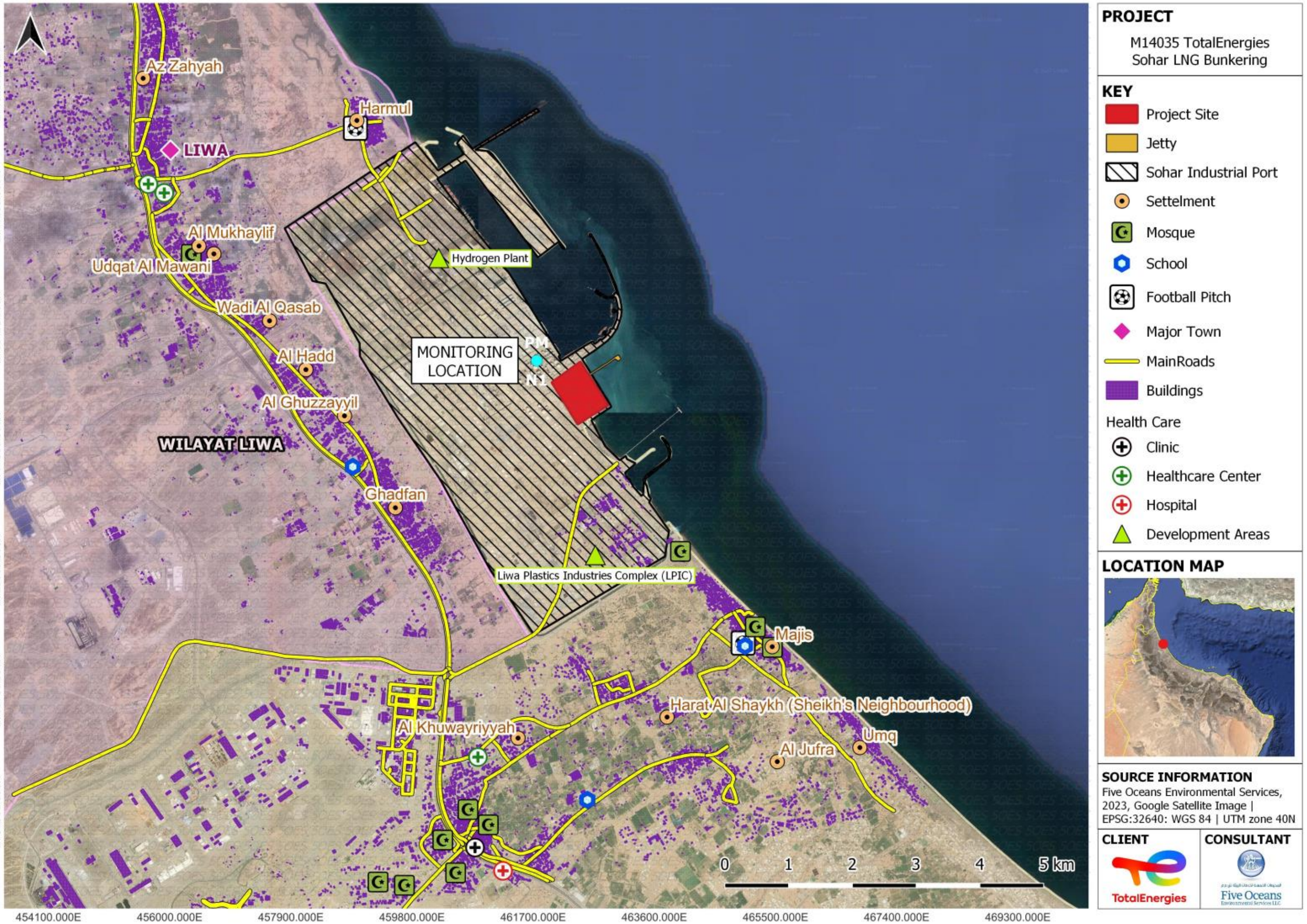
- The Liwa Plastics Industries Complex (LPIC): operational since from 2021, and located at about 1.7 km south from the Marsa LNG plot;
- Sohar Titanium Company (Titanium dioxide plant): located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in November 2022, under construction as of July 2023, operations expected to commence in 2025;
- A Petcoke Calcination Plant located in the Freezone area, around 10 km from Marsa LNG plot, which has now started commissioning activities;
- Sohar Steel Rolling iron and steel manufacturing: located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in June 2022; construction has not started yet at the time of writing this report;
- Arkan Sohar Logistics Container Freight Station (CFS) and logistics complex (warehouse facility): agreement signed in 2022 but timeline of construction was unknown at the time of writing this report;
- Hydrogen plant at Sohar, inside the exiting Jindal Shadeed facility, which will decarbonize the steel production process of Jindal Shadeed´s iron and steel manufacturing plant; construction timeline unknown at the time of developing this report.
- A rail connection between Sohar Port area and Buraimi is planned and is currently being tendered for detailed design and construction. No publicly available information is at the time of writing.
- A solar farm was constructed in 2022 in the Sohar Free Zone to provide power to the ferro-chrome smelter.

From exchanges with SIPC (email exchange of the 08/09/2023), it is undertood that the main development in the port currently in operation is the Liwa Plastics Industries Complex (LPIC) project and that during the commissioning of the plant, for a few months, there were increased noise emissions until the plant stabilized and the flaring activity reduced. Noise levels returned to the pre-start-up levels after commissioning of the plant was completed. During that period there were some complaints raised from the community that were redirected to OQ.

In SIPC's opinion, considering that since 2021 the LPIC is in its operation phase and that there is no high nor significant additional noise sources from other industrial sites, the 2019 noise baseline measurements carried out in 2019 remain valid. These have been presented in the sections below.

4.1.6.1 Noise Survey December 2019

Noise was measured using a hand-held Bruel & Kjaer 2250 during December 2019 at one location on a nearby facility for a period of 24 hours (See Figure 4-15). No exceedances were detected over the prescribed industrial limits of 70 dB. Maximum levels are shown in Table 4-9 to occur during periods of highest vehicular movement. However, overall noise levels over the sampling period were compliant with limits stipulated in legislation.



Boundaries of the facility and coordinates of sampling locations are not exact and are provided as a guide only.

Figure 4-15 Noise Monitoring Location (N1)

Table 4-8 Monitoring Location Coordinates.

Boundary Sampling Location	Latitude (º)	Longitude (º)
N1	24.492662165	56.620351846

Coordinates of the monitoring sites are not exact and are provided as a guide only.

Table 4-9 Summary of 24-hour Noise Results

Date and Time	LAeq (dB)	LAFMax (dB)	LAFMin (dB)
29-Dec 12:00	62.4	74.3	57.7
29-Dec 13:00	57.8	85.9	53.6
29-Dec 14:00	60.6	78.1	53.2
29-Dec 15:00	61.5	81.8	53.3
29-Dec 16:00	62.0	84.6	54.3
29-Dec 17:00	61.5	87.4	54.1
29-Dec 18:00	61.0	80.5	52.9
29-Dec 19:00	60.3	75.7	48.1
29-Dec 20:00	61.2	75.6	55.7
29-Dec 21:00	61.8	75.8	55.6
29-Dec 22:00	60.7	76.1	50.4
29-Dec 23:00	60.6	77.0	51.2
30-Dec 00:00	62.0	75.8	56.6
30-Dec 01:00	60.4	76.1	54.5
30-Dec 02:00	61.1	76.6	55.2
30-Dec 03:00	59.8	76.8	53.9
30-Dec 04:00	59.4	76.8	54.1
30-Dec 05:00	59.9	73.3	54.4
30-Dec 06:00	60.4	76.6	54.6
30-Dec 07:00	60.4	79.4	53.2
30-Dec 08:00	61.2	75.7	55.7
30-Dec 09:00	63.6	76.9	55.4
30-Dec 10:00	60.9	78.6	53.6
30-Dec 11:00	59.7	78.9	53.0

4.1.6.2 Noise Survey February 2020

A second noise survey was carried out between 27 - 29 February 2020.

4.1.6.2.1 Noise Monitoring Locations

The Project site is located in an industrialised area; the nearest residential areas are sited at a distance of ~2 km from site.

For the scope of this study, the following monitoring locations were selected:

- Maritime College, located ~1.2 km south from the Marsa LNG site (N1 and N2);
- Neighbouring residential area, located ~2.25 km south from the Marsa LNG site (N3).

Monitoring locations are listed in Table 4-10 and showed in Figure 4-16.

Table 4-10 Characteristics and Coordinates of Noise Monitoring Locations

ID	Description	North	South	Comments
N1	International Maritime College – Training Unit Roof top	24.46549 o	56.64587o	Noise levels from natural sources (i.e. waves was recorded) and bird activity
N2	International Maritime College – College Entrance Gate	24.46616 o	56.64481 o	Vehicle movement and wind was recorded
N3	Residential Area	24.46198	56.64635	Vehicle movement and wind was recorded

Source: 5OES, 2020.

Source: ERM, 2023.

Figure 4-16 Noise Monitoring Locations

4.1.6.2.2 Noise Monitoring Methodology

The Project site is characterised by the presence of existing industrial activities (i.e. Oil Tanking Facilities nearby, Power Plants, etc) that already affect the local acoustic climate. A noise monitoring campaign was conducted to record the current background noise levels of the Project site and its surroundings:

- Continuous 48-hour measurement was performed at the Omani International Maritime College in Sohar roof top (N1) (note: instrument located on the roof for security constraints);
- Short-term measurement (1 hour) during the day at the entrance gate of the International Maritime College (N2);
- Short-term measurement (1 hour) at a nearby residential area during Day, Evening, and Night (N3).

The noise monitoring survey was performed in compliance with the requirements set by the ISO 1996-Part 2 “Determination of environmental noise Levels” guidance, by means of two Bruel & Kjaer 2250 sound level meter. Measurements were carried out in dry conditions (i.e. not when it is raining) and in absence of relevant wind conditions (i.e., wind speed below than 5 m/s). The instrument was calibrated before and after each cycle of the measurement and no significant calibration drift was detected.

For each measurement, the sound level meter recorded the following acoustic parameters: $L_{Aeq,t}$, L_n percentile levels (e.g., L_{10}, L_{90}), L_{Max} and L_{Min} values. Alongside abovementioned acoustic parameters, the coordinates of the noise monitoring locations were determined using GPS and site characteristics, including photographic reference, were documented.

4.1.6.2.3 Noise Monitoring Results

Table 4-11 shows the results of the noise measurements at the selected locations.

Table 4-11 Noise Monitoring Results

ID	Date	Measurement Period	Elapsed Time	Monitored Background Noise [dB(A)]				
				LAeq,t	Lmax	Lmin	L10	L90
N1	27th Feb - 29th Feb 2020	Daytime	48 h	48	72	44	49	47
		Evening		50	70	47	51	49
		Night		50	63	47	51	49
N2	28th Feb 2020	Day	1 h	67	47	53	55	50
N3	28th Feb 2020	Daytime	1 h	66	38	48	51	41
		Evening	1 h	63	39	45	46	41
		Night	1 h	63	40	44	45.5	42

Notes:
L10 = The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
L90 = The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.

Source: 5OES, 2020.

Monitoring site N3, located at the village of Majis, is sited in an area that can be classifed as “urban residential area”; the applicable noise standards for residential areas are:

- 55 dB(A) for daytime, 50 dB(A) during the evening, and 45 dB(A) during night-time, according to national legislation (MD 79-94);

- 55 dB(A) for daytime and 45 dB(A) for night-time, according to IFC guidelines.

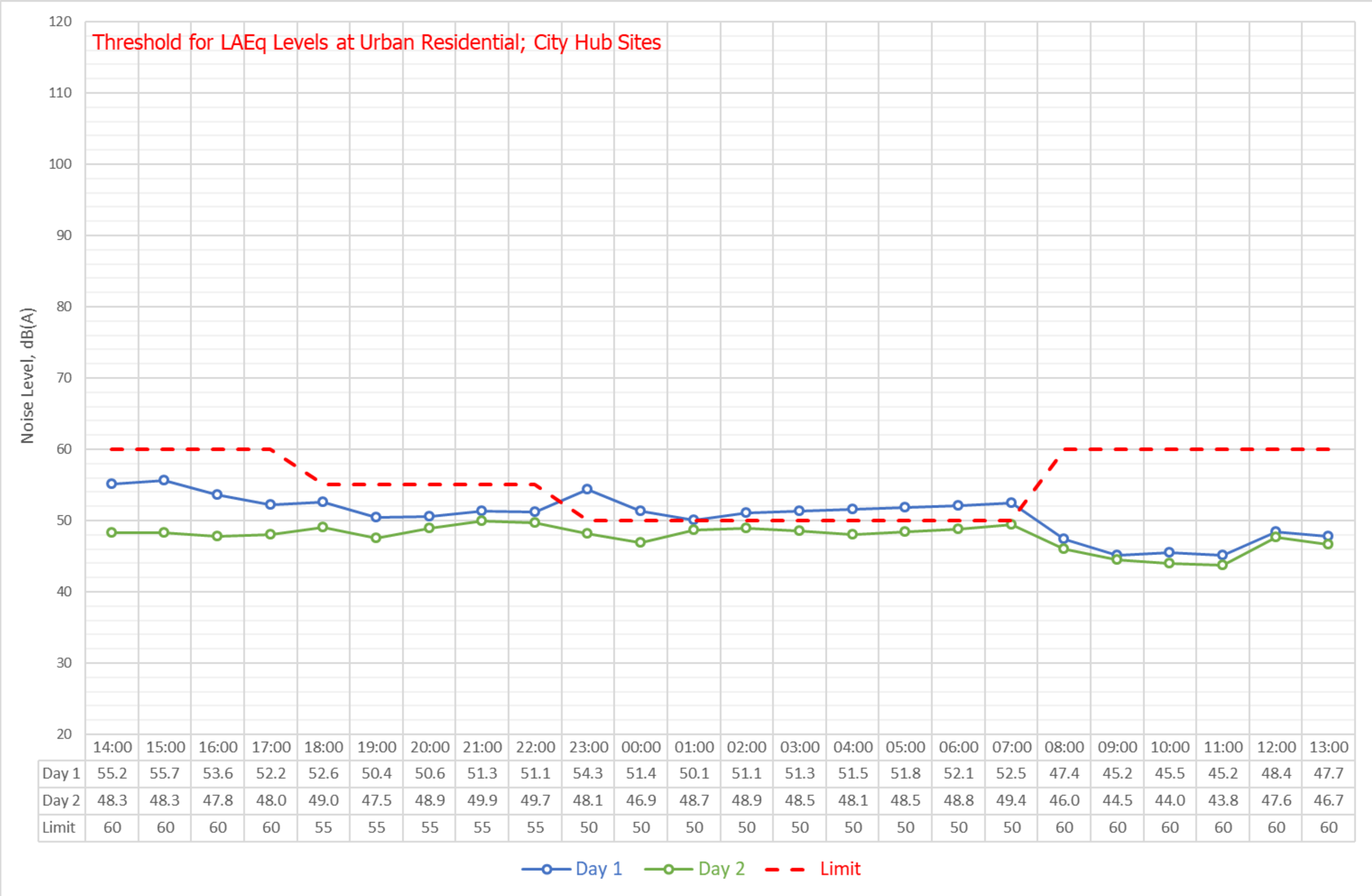
N1 and N2 monitoring sites are located at the Omani International Maritime College. This area is located close to the industrial zone and can be considered as an extension of the port maritime area, within the SIPC boundaries. For industrial areas both national and IFC standards set a noise limit of 70 dB(A) for daytime, evening and night-time.

The monitoring results reported in Table 4-11 were compared to the applicable noise standards:

- At monitoring sites N1 and N2, the background noise levels were below the noise limits for industrial areas both during day, evening and night-time (70 dB(A)). The noise levels monitored at N1 were below the background noise at N2. This can be a consequence of the location of the instrument on the roof of the building, in a higher position than the exiting noise sources (i.e. industrial facilities and road traffic).
- At monitoring site N3, the background noise levels varied between 66 dB(A) and 63 dB(A), well above the noise limits set by national and IFC standards for residential areas, during all periods (day, evening, night). During the daytime, an exceedance of 11 dB was monitored (limit of 55 dB(A)), during evening an exceedance of 13 dB (limit of 50 dB(A), and at night an exceedance of 18 dB (limit of 45 dB(A)). 6 decibels over the urban residential national limit for daytime, and 11 decibels over the IFC standards. The hourly noise levels monitored at N3 showed a background noise level quite unchanged from the day to the night (minor variation of 3 dB), typical of steady sources of noise throughout the day.

The results of the monitoring survey confirmed an acoustic climate at nearest settlements already affected by noise from the existing industrial facilities and from the road traffic. The main existing noise sources recorded during the monitoring campaign were:

- N1: Vehicle movement during night-time, natural noise from waves and birds,
- N2: Noise levels from slight wind and waves,
- N3: Vehicle movements and natural wind noise levels.



	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00
Day 1	55.2	55.7	53.6	52.2	52.6	50.4	50.6	51.3	51.1	54.3	51.4	50.1	51.1	51.3	51.5	51.8	52.1	52.5	47.4	45.2	45.5	45.2	48.4	47.7
Day 2	48.3	48.3	47.8	48.0	49.0	47.5	48.9	49.9	49.7	48.1	46.9	48.7	48.9	48.5	48.1	48.5	48.8	49.4	46.0	44.5	44.0	43.8	47.6	46.7
Limit	60	60	60	60	55	55	55	55	55	50	50	50	50	50	50	50	50	50	60	60	60	60	60	60

Source: 5OES, 2020.

Figure 4-17 Noise levels recorded over a 48 hour period at N1

4.1.7 Geological Framework

The project is located in the North East of Oman and lies in the Al Batinah Coastal Plain. This plain extends from the Al Hajar Mountains to the Gulf of Oman in the east. The Al Batinah plain is dominated by late tertiary to quaternary fluvial deposits which extends from the mountains to the sea. The Hajar Mountains have been formed by upthrusting of the Arabian plate as it is subducted below the Eurasian plate along the Makran thrust fault, exposing thick limestone sequences on western flanks of the mountain range, while on its eastern flanks the underlying Semail ophiolite is exposed.

The Semail Ophiolite is primarily made of magnesium silicate rocks and is considered quite unique to Oman due to its various deposits of minerals that are rich in nickel, chromium, copper and other heavy metals. Erosion products from the Hajar Mountains are carried along the wadi beds during periodic storm events and contribute significantly to the formation of marine sediments along this section of coastline.

The coastal zone that surrounds Sohar Port is flat and is composed of extensive sand and gravel plains. Immediately adjacent to the landward side of the coast are aeolian sands. These sands intermingle with deposits of clay and silt, although a thin veneer of beach sand stretches along the foreshore (Halcrow, 2015).

In the centre of the Al Batinah plain, a deep Neogene sedimentary basin is located. This basin is filled in with sediments belonging to the Fars Group and younger alluvium which consist of gravels with underlying cemented gravels.

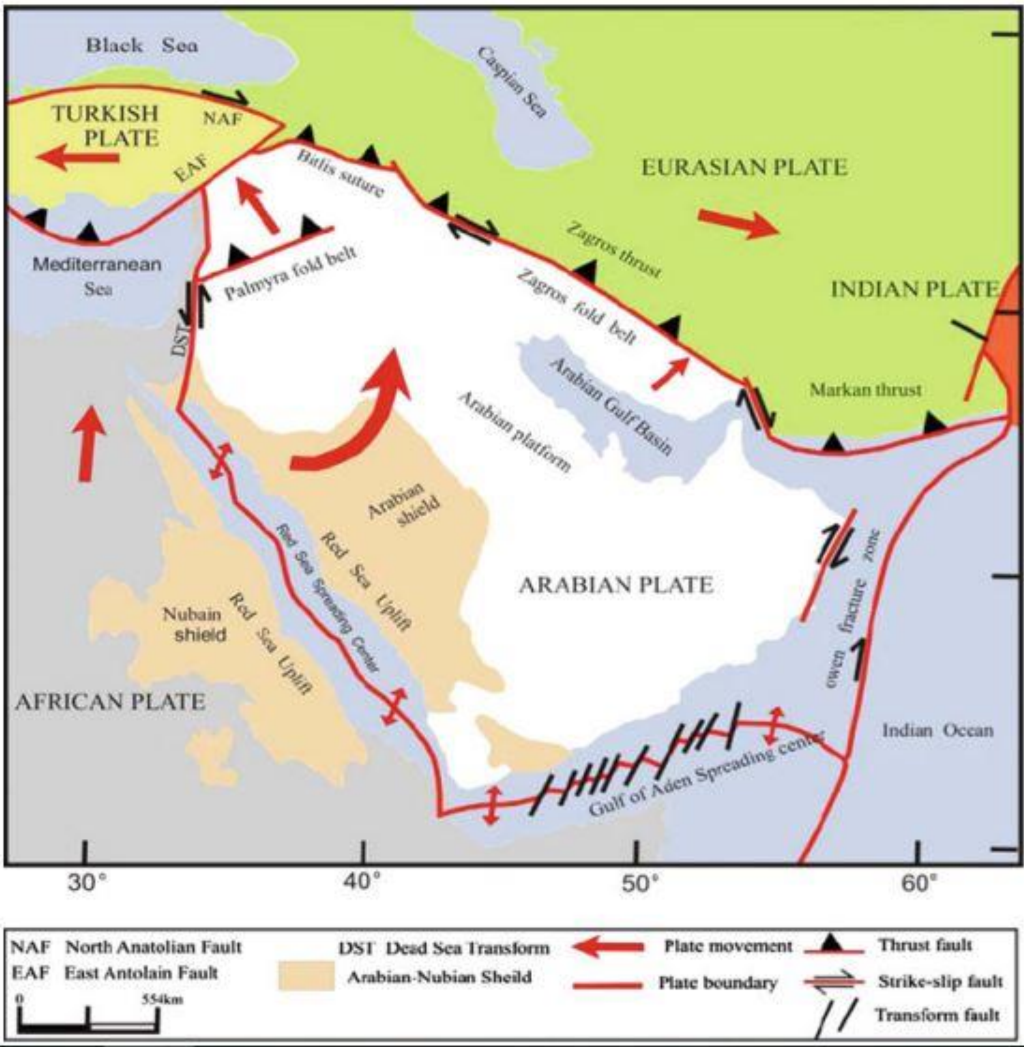
4.1.7.1 Seismicity

Oman is located on the north-eastern margin of the Arabian plate which, through continental collision, has given rise to the folded Zagros Mountains as shown in Figure 4-18. The oceanic part of the Arabian plate is subducting along the Makran Trench which is marked by intense earthquake activity. As the Arabian plate moves north-eastwards, parts of the plates are differentially deformed and periodic release of such stress accumulations causes earthquakes at the edge of the plate. The 1971 Al-Kamil earthquake in Oman is a rare example of an intraplate earthquake that has been recorded in the global USGS database.

The United States Geological Services (USGS) maintains a database of seismic events including those recorded in the Sultanate of Oman. There are no USGS established seismic stations in Oman and as a result, only regional data is available that indicate the potential frequency and magnitude of seismic events as shown in Source: El-Hussain et al. 2010.

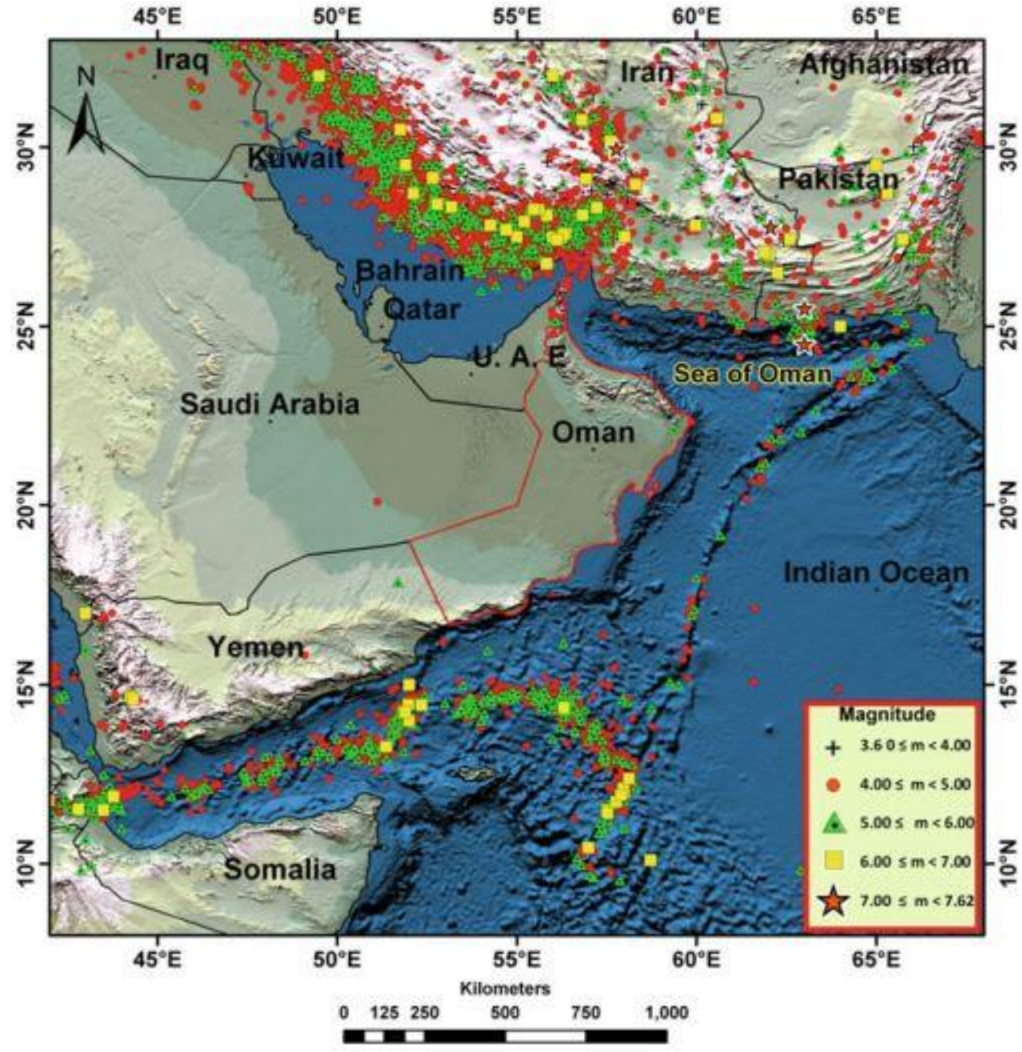
Figure 4-19. This figure indicates that the magnitude of seismic events in Oman range between 4 to 5 on the Richter scale. The figure also shows that no recorded seismic events were recorded in the northern Al Batinah region.

The USGS calculates peak ground acceleration for the Middle Eastern region as shown in Figure 4-20. Peak ground acceleration is a measure of ground motion as a result of seismic or other activities. The figure delineates the north-eastern region of relatively higher seismic hazard from the rest of the country which is characterized by lower hazard levels. Seismic activity in Muscat and Sohar for the past 475 years is dominated by intense but distant earthquakes (El-Hussain et al. 2012). This indicates that Seismic sources close to the city are of low activity rates. High ground motion levels at short distances are not likely to occur which suggest a low to moderate level of seismicity in the area of interest.



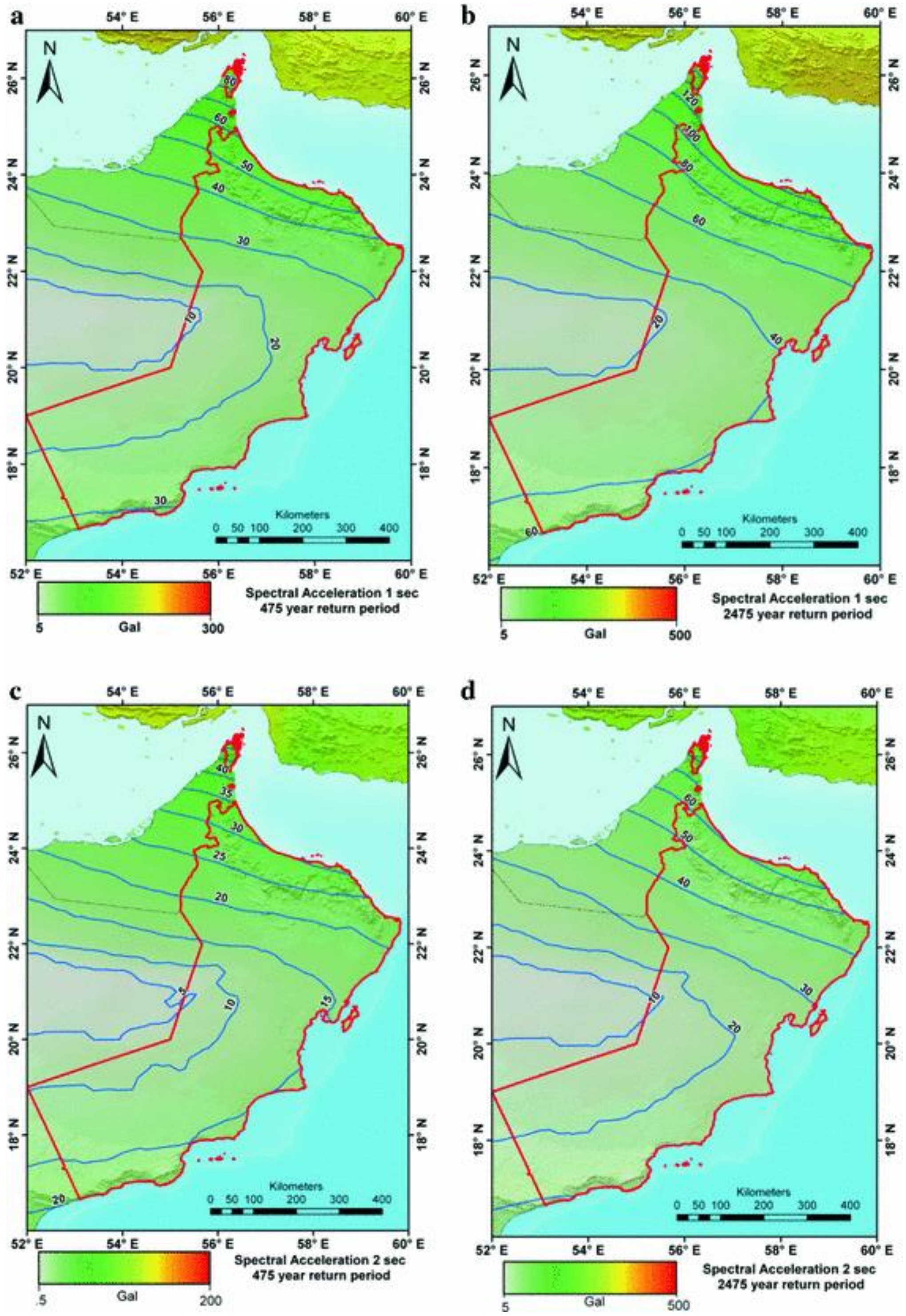
Source: El-Hussain et al. 2010

Figure 4-18 Tectonic Elements Surrounding the Arabian Plate



Source: El-Hussain et al. 2010.

Figure 4-19 Instrumental Seismicity of Oman from 1904 to 2008

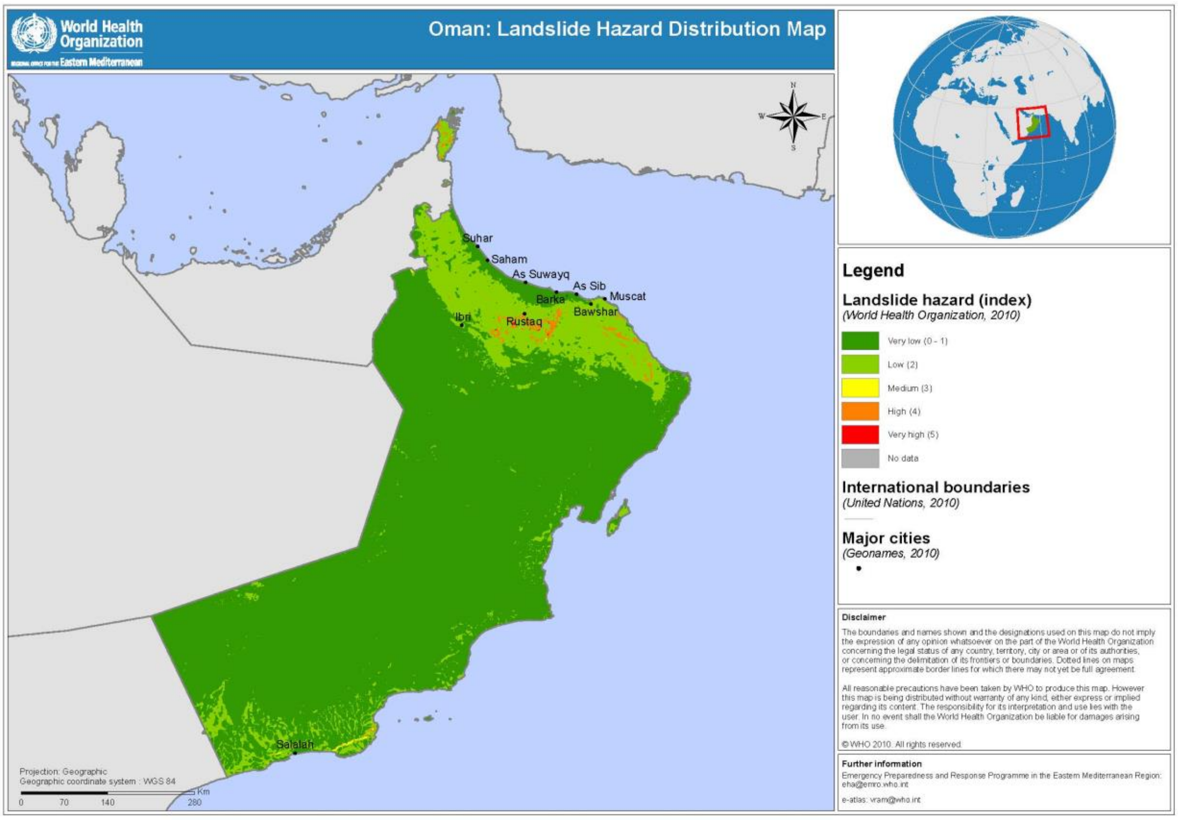


Source: El-Hussain et al, 2010

Figure 4-20 Mean Peak Ground Acceleration (cm/s^2) in the Sultanate of Oman

4.1.7.2 Landslides

According to the World Health Organization (WHO, 2010), (Figure 4-21) the susceptibility of the Sultanate to landslides is very low. The reclaimed low-lying topography nature of the site also suggests that the potential for landslide hazards is negligible and does not pose a threat to the project.



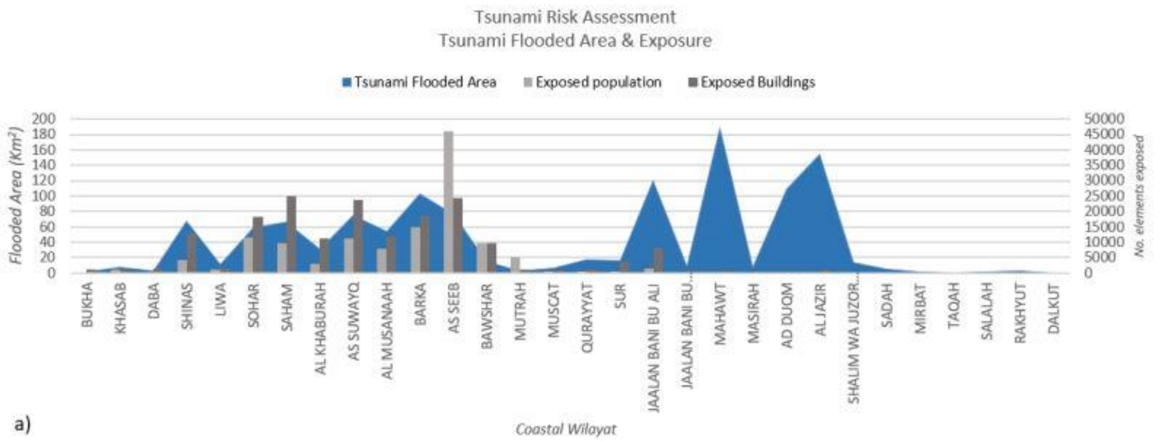
Source: WHO, 2010

Figure 4-21 Landslide Hazard Distribution Map

4.1.7.3 Tsunamis

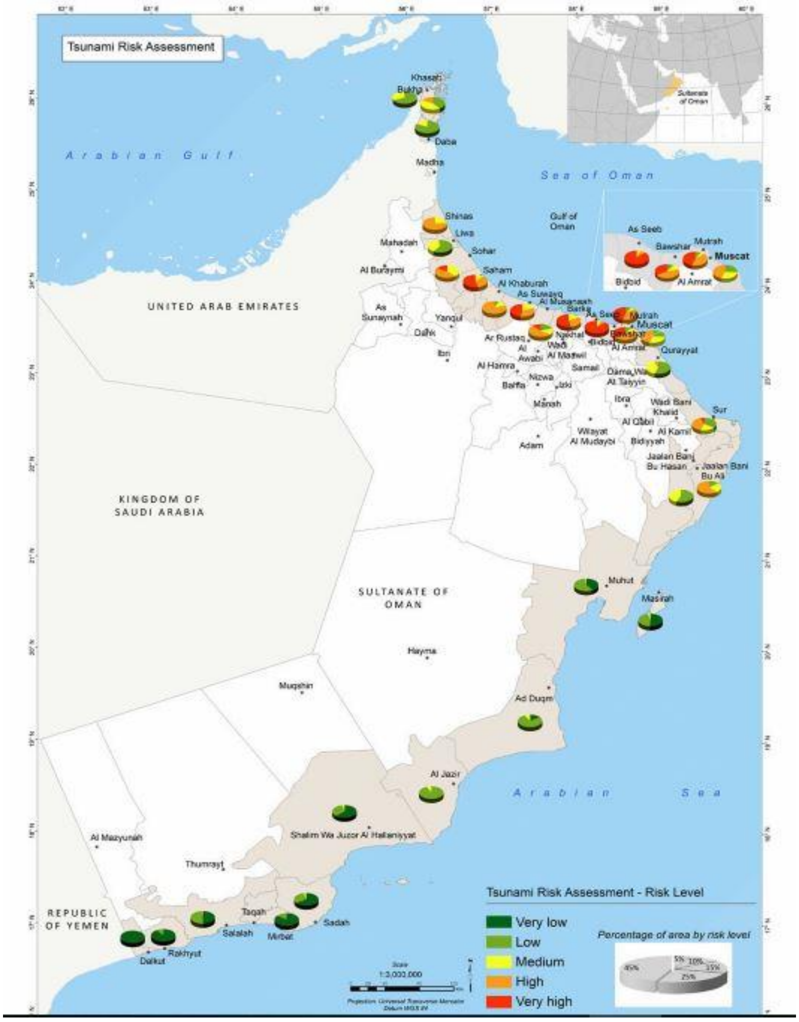
Oman is located facing the Makran subduction zone as shown in Figure 4-18. This triggers the risk of tsunami events occurring near the Omani coastline. Historically, the frequency and intensity of events in Oman has been low due to the shallow nature of the coastline with no volcanic activity. Sedimentological evidence and archaeological data suggest that tsunamis have previously impacted the Omani coastline; the most recent being the 1945 Makran event which affected the eastern shoreline of Oman; only minor damage was reported.

A tsunami risk assessment (Ignacio et. al, 2018) suggests that in the event of a tsunami, the most susceptible areas to flood impacts are located in the North of Oman including Sohar. The locations with the highest infrastructure and population exposure to tsunami impacts are the Wilayat of Bawshar in Muscat to Wilayat Shinas as shown in Figure 4-22; with the exception of Liwa located near the project site. Despite the low occurrence of tsunamis in the region, the risk of its occurrence is prevalent. As a result, the project design phase will require to assess protection measures against its associated impacts.



Source: Ignacio et al. 2018

Figure 4-22 Tsunami Risk Assessments of Wilayats in Oman



Source: editor.copernicus.org; accessed: 28.01.2019

Figure 4-23 Tsunami Risk Assessment Map in Oman

4.1.8 Landscape and Visual

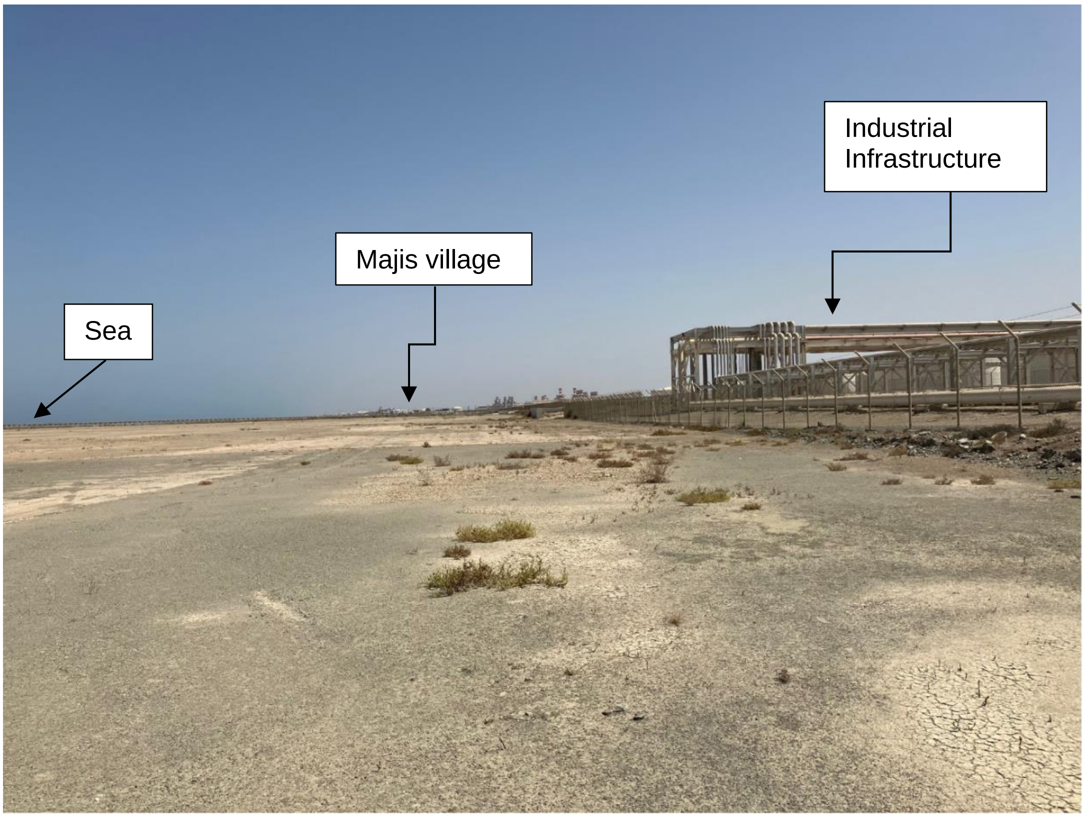
The Sohar Port area is located on the coastal plain and therefore has a visual aesthetic. The landscape has features such as wadis and low-lying hills, however, the industrial nature of the wider area is now an established character of the landscape for over a decade (see next figures).
The Project will require additional industrial facilities to be constructed in the area and will incrementally contribute to the industrial context of the existing landscape.

Source: Stakeholder Engagement Survey, October 2019.

Figure 4-24 Visual Landscape of the Port from Harmul Village

Source: Initial Site Visit, September 2019

Figure 4-25 Visual Landscape at Nearby Fishing Community. Evidence of Flaring



Source: MARSA Site Visit, August 2023

Figure 4-26 Visual Landscape of Project Site towards Southeast

Source: MARSA Site Visit, August 2023

Figure 4-27 Visual Landscape of Project Site towards the Sea

Source: MARSA Site Visit, August 2023

Figure 4-28 Visual Landscape of Project Site towards Northwest

4.2 Terrestrial Ecology

4.2.1 Terrestrial Ecoregions

There are three terrestrial ecoregions within the Oman Mountains ecoregion as shown in Figure 4-29. The Gulf of Oman desert and semi-desert terrestrial ecoregion includes the low-lying Batinah plain that stretches 270 km between the foothills of Al Hajar Mountains and the sea (Databasin, 2020). This ecoregion surrounds the base of the Al Hajar Mountains and includes a complex system of wadis that drain the mountain slopes. Common indigenous tree species include *Zizyphus spina-christi*, Ghaf (*Prosopis cineraria*), and umbrella thorn acacia (*Acacia tortilis*). The Al Hajar montane woodlands characterize the mountain region, with species such as *Moringa peregrina*, the fig trees *Ficus cordata salicifolia*, *F. johannis*, umbrella thorn acacia, and *Prunus arabica*. The interior part of the ecoregion is characterized by the Arabian Desert and East *Sahero-Arabian xeric* shrublands. Typical species in this ecoregion include *Calligonum crinitum*, saltbush (*Cornulaca arabica*), and the sedge *Cyperus conglomeratus*.

The Project site will be constructed on reclaimed (unvegetated) land, zoned for industrial use which does not support any significant ecology (e.g.,No endangered flora and fauna species are found in the immediate area.

4.2.2 Main Habitats

Two main vegetation types occur in the region: a community that dominates the foothills and gravel plains in Northern Oman and a community of halophytic shrubs which dominates the coastal strip. Vegetation in the general area of the Project is dominated by *Acacia tortilis* trees and a variety of associated shrubs while wadis and wadi banks support a higher diversity of annual species at certain times of the year (Ghazanfar, 1999).

Gravel plain and wadi habitats border the north west of Sohar Port and typically included scattered *A. tortilis* trees and small shrubs (*Fagonia indica*). East of the project site closer to the Freezone area, *Ziziphus spina-christri* trees can be found in the wadi channels alongside *Fagonia indica* (Ghazanfar and Fisher, 2011).

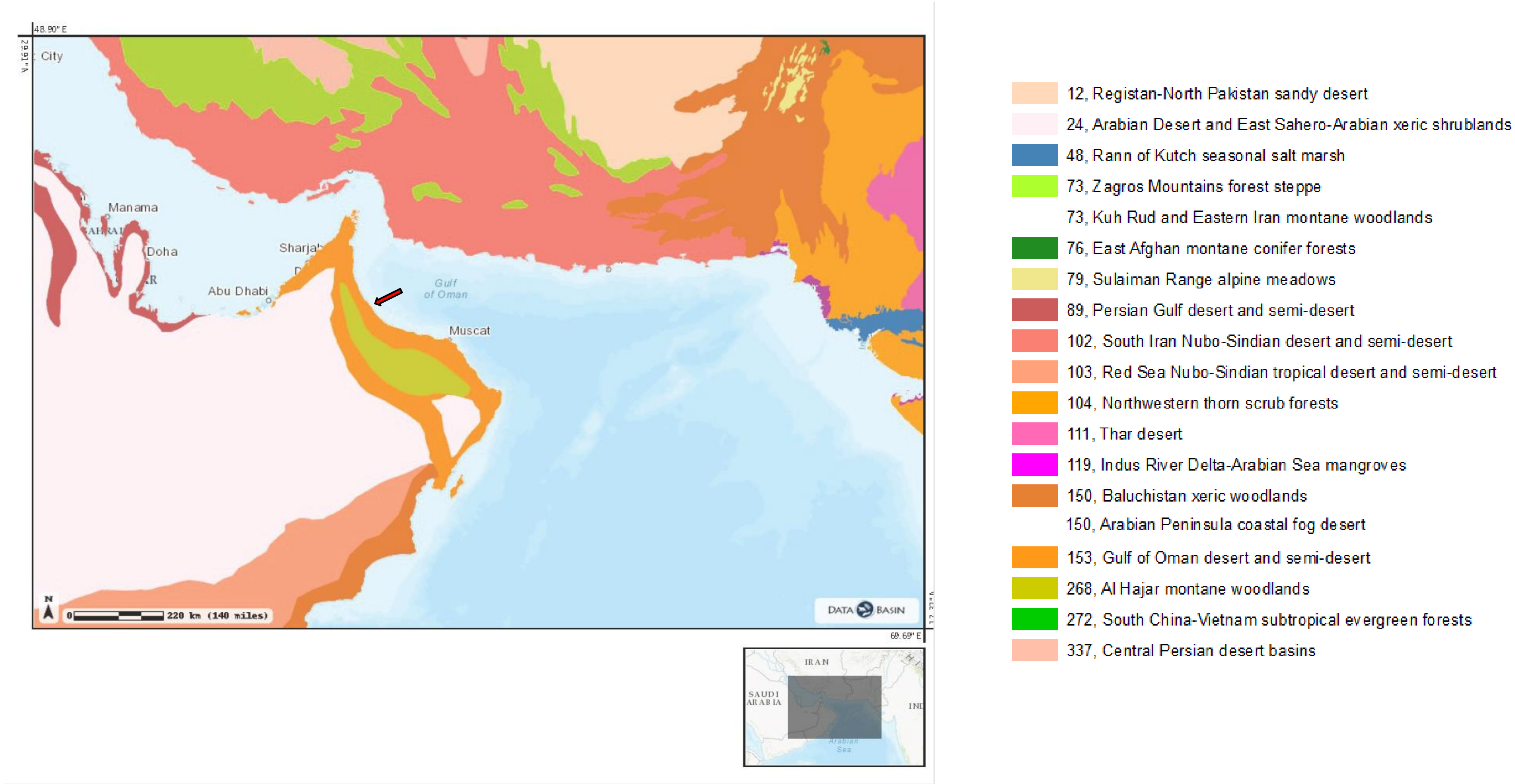
Other species that are characteristic of gravel and wadi habitats that may surround the Project site include shrub species such as *Jaubertia aucheri*, two species of Goat's Head (also known as Devil's Thorn, *Tribulus terrestris* and *Tribulus omansense*), a species of thistle (*Blepharis ciliaris*), Fuzzy deutzia (*Deutzia scabra*), *Ochradeneus arabicus* (a regional endemic that is palatable for browsers), the oleander *Olea aucheri*, the shrub *Chrozophora oblongifolia* (a regional endemic) and Saxaul (*Haloxylon salicornicum*) (Ghazanfar and Fisher, 2011), In deeper wadi channels, vegetation has been scoured from the wadi bed by flowing water, but smaller shrubs and grasses are typically densely established in these systems. Mature woodland within the region typically consists of 8 trees/ha in the more vegetated areas of the site, with an overall average of approximately 4 trees/ha.

4.2.3 Flora and Fauna

An ecological survey investigation conducted by 5OES in 2020 near the Project vicinity observed Bats (likely *Rhinopoma sp*.; mouse-tailed bats) and Arabian red fox (*Vulpes vulpes*). Abundance of mammals is expected to be very low in the project vicinity, although herptile diversity, particularly lizards, may be greater (~ten observed species).

A small number of birds were observed during the investigation apart from ubiquitous house sparrows (*Passer domesticus*) and doves (*Streptopelia* spp.) Other species observed on site included the yellow-vented bulbul *(Pycnonotus goiavier)* and three purple sunbirds (*Nectarinia asiatica)*, all of which were seen flying between *A*. *tortilis* trees in the wadi channels. Despite the apparent scarceness of birds close to the project site, a number of *A*. *tortilis* trees were seen to contain nests. It is expected that the number of bird species utilizing the relatively dense wadi vegetation is substantially higher than were accounted for during the survey. It's also noteworthy that BirdLife International has identified important bird areas (IBAs) in coastal Khawrs located ~5-20 km from site (e.g., Khawr Harmul) and the Al Batinah shoreline is considered important as a migratory pathway for waders and shorebirds.

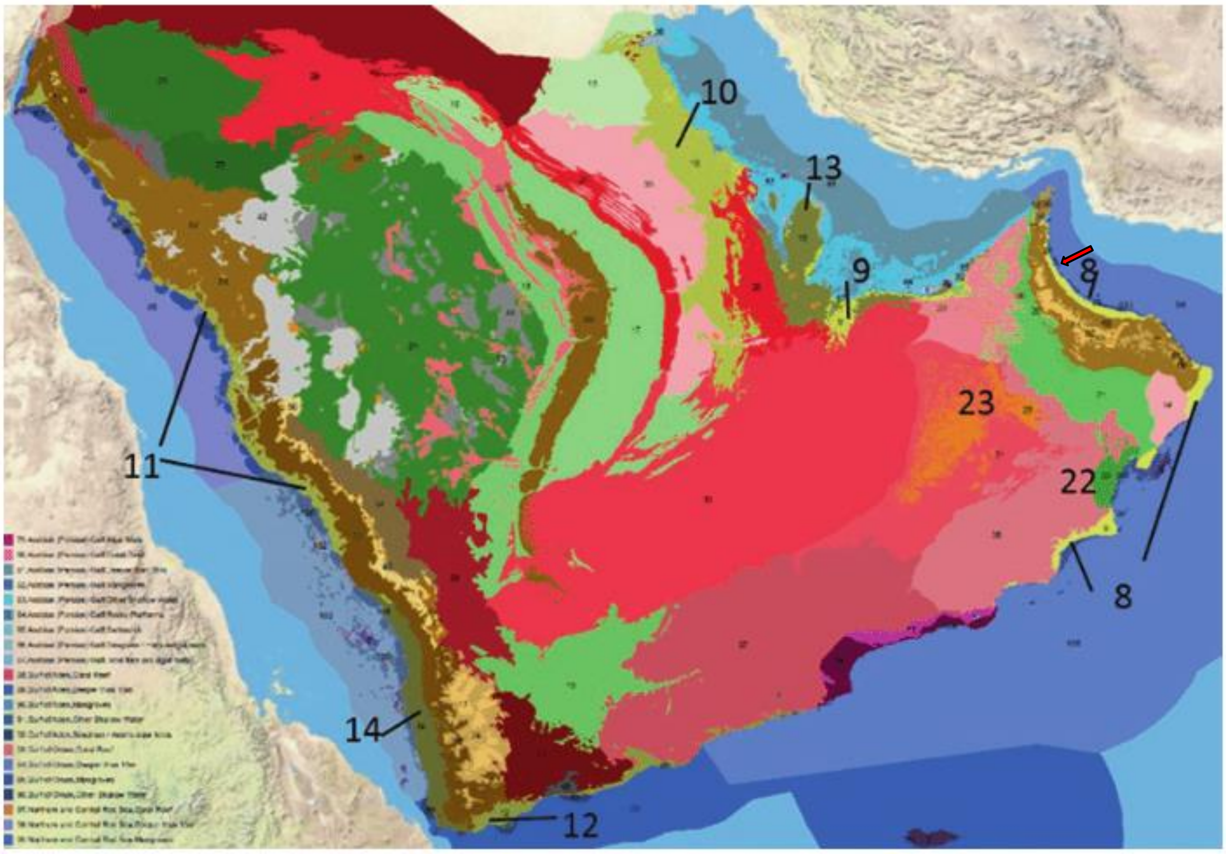
Invertebrate presence was minimal with only painted lady butterflies (*Vaness cardui*), Arabian paper wasp (*Polistes watti*), grasshoppers (Acrididae), potter wasp (*Delta dimidiatipenne*), unknown termite species, a large number of ants (Formicidae) and antlion burrows (Myrmeleontidae) were recorded. A substantial number of unidentified moths were noticed in the wadi where the bats were observed and it is likely the bats were feeding on those insects. No scorpions were recorded.



Source: Databasin.org; accessed 23.01.2020

Note: Red arrow indicates project location

Figure 4-29 Ecoregion Map of the Sultanate of Oman



1 Integrated terrestrial and marine habitat map of the Arabian Peninsula Major coastal and inland sabkhas of the Arabian Peninsula: 8, Oman Coastal Plain; 9, Gulf Coastal and Sabkha Matti; 10, Northern Gulf Coastal Plain and Sabkha; 11, Red Sea Coastal Plain and Sabkha; 12, Southern Coastal Plain; 13, Southern Gulf Coastal Plain; 14, Tihama Coastal Plain; 22, Inland Sabkha Huqf; 23, Inland Sabkha Umm as Samim. Source: Abu Dhabi Global Environment Data Information (AGEDI 2013). Reproduced with permission

Source: AGEDI, 2013; accessed: 28.01.2020

Figure 4-30 Terrestrial and Marine Habitat Map of the Arabian Peninsula

4.2.4 Protected and Designated Areas

There are no official protected areas in the vicinity of the project; nonetheless, BirdLife International (2020) reports that about 300 km of exposed sand beach from As-Seeb in Muscat to Shinas in the North of Al Batinah, where the Project is located, has been designated as an A4i IBA site since 1994 (Al Batinah Coast IBA); which pre-dates the development of Sohar Port. A4i sites are known or thought to hold, on a regular basis, 1% or more of a biogeographic population of a congregatory waterbird species (Hall, 2005).

Source: 5OES, 2023.

Figure 4-31 Terrestrial Ecology Map of the Project Site

The Al Batinah Coast IBA comprises khawrs (creeks) that frequently occur at the mouths of drainage lines; most are transitory, appearing and disappearing according to the occurrence of strong tides and wadi-floods. Important numbers of waterbirds occur in winter, especially large numbers of Sanderling (*Calidris alba*) and roosting gulls and terns; the latter often concentrate at the small khawrs (Birdlife International, 2023). Additional species observed in the Al Batinah Coast IBA are shown in Table 4-12. Ten species have been listed for this IBA; all of them are categorized as Least Concern (LC), meaning that they do not qualify for Endangered (EN) or Near Threatened (NT) according to IUCN Red List criteria.

Table 4-12 Species List for Al Batinah Coast IBA (Birdlife International, 2023)

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered	Usage of Al Batinah IBA
Lesser Sandplover *Charadrius mongolus*	LC	winter	1989-1992	277-322 individuals	B1i	Native non-breeding
Kentish Plover *Charadrius alexandrinus*	LC	winter	1989-1992	222-341 individuals	B1i	Native resident, non-breeding
Sanderling *Calidris alba*	LC	winter	1989-1992	356-2,500 individuals	A4i, B1i	Native, non-breeding
Slender-billed Gull *Larus genei*	LC	winter	1989-1992	822-1,722 individuals	A4i, B1i	Native, non-breeding
Black-headed Gull *Larus ridibundus*	LC	winter	1989-1992	23,704-35,526 individuals	A4i, B1i	Native, non-breeding
Pallas's Gull *Larus ichthyaetus*	LC	winter	1989-1992	1,216-3,801 individuals	A4i, B1i	Native, non-breeding
Mew Gull *Larus canus*	LC	winter	1990	1,650 individuals	B1i	No data, but not thought to be breeding
Lesser Black-backed Gull *Larus fuscus*	LC	winter	1989-1992	568-1,754 individuals	A4i, B1i	Extant (resident) in Oman
Caspian Gull *Larus cachinnans*	LC	winter	1989-1992	1,137-3,507 individuals	B1i	Extant (resident) in Oman
Greater Crested Tern *Thalasseus bergii*	LC	non-breeding	1989-1992	265-490 individuals	B1i	Extant (resident) in Oman, non-breeding

Note: LC = Least Concern.

On the other hand, there are other designated IBAs in Khawr Shinas and Khawr Liwa, approximately 5 km and 20 km North of the Project respectively. In this IBA, species such as the black-headed gull (*Larus ridibundus*; 2,500 individuals; A4i, B1i), the Caspian gull (Larus cachinnans; 930 individuals; B1i), and the collared kingfisher (*Todiramphus chloris*; 1 individual; B2) are reported in the khawrs; all of these species are categorized as Least Concern by the IUCN.

In addition, there is another IBA called Sun Farms at about 22 km southeast from the Project. IBA Sun Farms comprises large agricultural fields irrigated by rotary gantries on the Al Batinah coast and concentrates large numbers of birds attracted to the water, greenery and spilt grain during migration and winter. Two species have triggered the need for this IBA: the Eastern Imperial Eagle (*Aquila heliacal*, B2), categorized as Vulnerable by IUCN, with only 3 individuals reported wintering in 1993); and the Lesser Kestrel (*Falco naumanni*, A1/B2), categorized as Least Concern, with 66 individuals reported as passage in 1993).

5 MARINE ENVIRONMENTAL BASELINE

A critical source of existing marine environmental baseline information for the project area is the Sohar Port South (SPS) Expansion Project EIA report (WSP, 2019), since it contains the most recent survey results for the area and vicinity. Indeed, the plant will be built on reclaimed land constructed by the SPS Expansion Project, and ships will reach the loading jetty to be operated by MARSA LNG LLC via the approach channel that will be dredged by the same project. The SPS Expansion Project EIA considers the impacts arising from the construction of the LNG loading jetty which, since it will be exclusively operated by MARSA LNG LLC, is considered to be an associated facility according to IFC criteria. Shipping activity associated with the LNG facility, i.e., LNG loading and LNG bunkering, is also included in the scope of this assessment so the geographical boundaries have been set accordingly to define the content of the marine environmental baseline

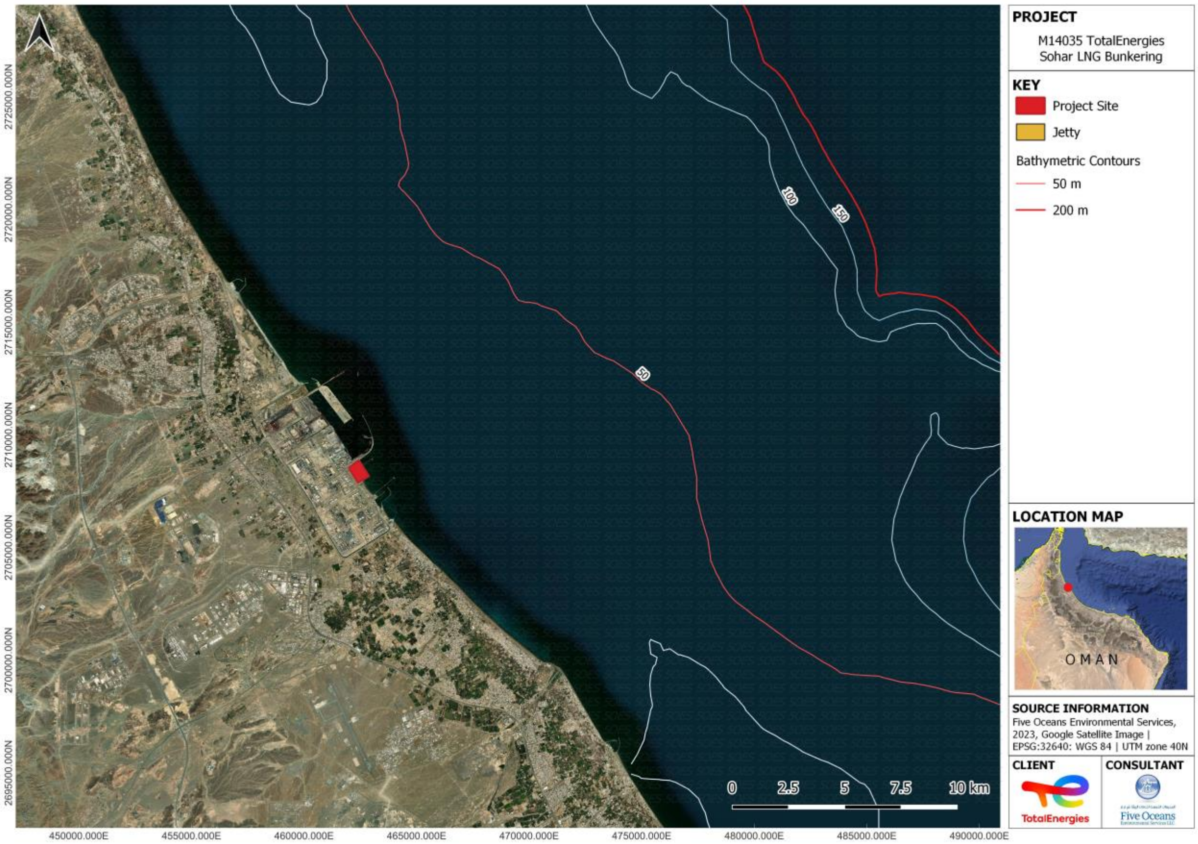
5.1 Physical Environment

5.1.1 Bathymetry

The MARSA LNG Bunkering Project area is located on the northeast coast of Oman on the Al Batinah coast, northwest of the city of Sohar, on the western edge of the Oman Sea, also known as the Gulf of Oman. The Oman Sea connects the Arabian Sea (northwestern Indian Ocean) in the south-east, to the Arabian Gulf (via the Strait of Hormuz) in the north-west. The Oman Sea measures approximately 200 km (north – south) by 600 km (SE to NW) with an area of around 9.03×10^5 km^2 and is bordered by the Sultanate of Oman to the south and Iran to the north.

In its deepest parts, the Oman Sea is approximately 3,000 m deep; bathymetric transects between Oman and Iran surveyed in 1993 recorded a maximum depth of approximately 1250 m, from a point on the Oman coastline close to Sohar (Reynolds, 1993). Closer inshore to Sohar Port, the bathymetry gently slopes uniformly alongshore, from a depth of approximately 200m at the continental shelf break (around 30 km offshore), to the shoreline.

Based on localised bathymetric surveys carried out in 2017 (Van Oord, 2017), water depths in the immediate vicinity of the Port breakwaters were measured at around 10 – 12 m depth, increasing slowly in depth towards the east.



Source: Google Satellite / GEBCO

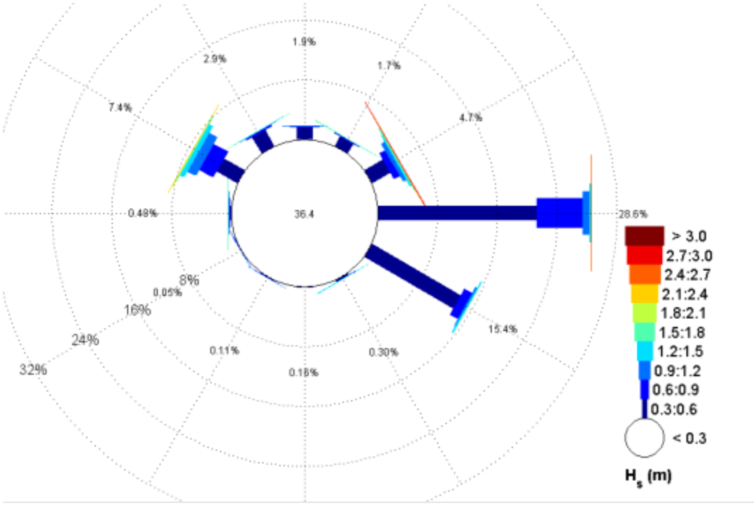
Figure 5-1 Bathymetric contours of the Sohar Port offshore area

5.1.2 Wave Climate

The wave fetch across the Oman Sea is limited, with winds being generally light to moderate. Under normal conditions, waves are therefore generally small, with heights less than 1.0 m, with significant wave heights >1.5 m tending to occur only during winter 'Shamal' events, which typically last 2-5 days.

Local tidal flow and wave regime around Sohar Port has been assessed using a depth-averaged flow model (Deltares, 2008) which established the baseline predictions upon which all design studies for the development of Sohar Port have been based. The majority of waves arrive at the Port from the east, while the more extreme waves arrive from the southeast and northeast (Figure 5-2) i.e., Arabian Sea and further south in the Indian Ocean. Average wave heights of 1.4m in are expected each year (i.e., a return period of one year) and around 4.0m waves are estimated during 1 in 100 year events (WSP, 2019). Additional modelling carried out by Deltares (2018a, b) confirmed normal wave characteristics in Sohar Port to be consistent with an earlier (2008) modelling study, with nearshore wave heights <1.0 m 95 % of the time.

In 2014, an Acoustic Doppler Current Profiler (ADCP) survey was conducted, with the instrument located near Wudam (approximately 140 km south-east of Sohar Port). During a 2-year deployment from 2006 to 2008 nearshore significant wave heights between 0.2 – 1.4 m were recorded, with wave periods in the order of 4 – 5 seconds (Al Hatrushi et al., 2014).



Source: Deltares, 2018a

Figure 5-2 ERA5 Wave Rose from Jan 2010 to Dec 2016 for Sohar Port

5.1.3 Tides

The tidal regime in Oman is mostly diurnal (two high and two low tides per day), with a mesotidal range of 2 – 4 m for the Northern Al Batinah region and averaged tidal currents below 0.1 m/s (Al Hatrushi et al., 2014; Deltares, 2018a). Localised water levels around Sohar Port are governed by a combination of tidal movement and storm surge forcing as a result of low atmospheric pressure and strong winds. Surge levels are linked to seasonal variations in atmospheric pressure rather than the wind climate (WSP, 2019). Table 5-1 contains a summary of the tidal data and levels from Sohar Port.

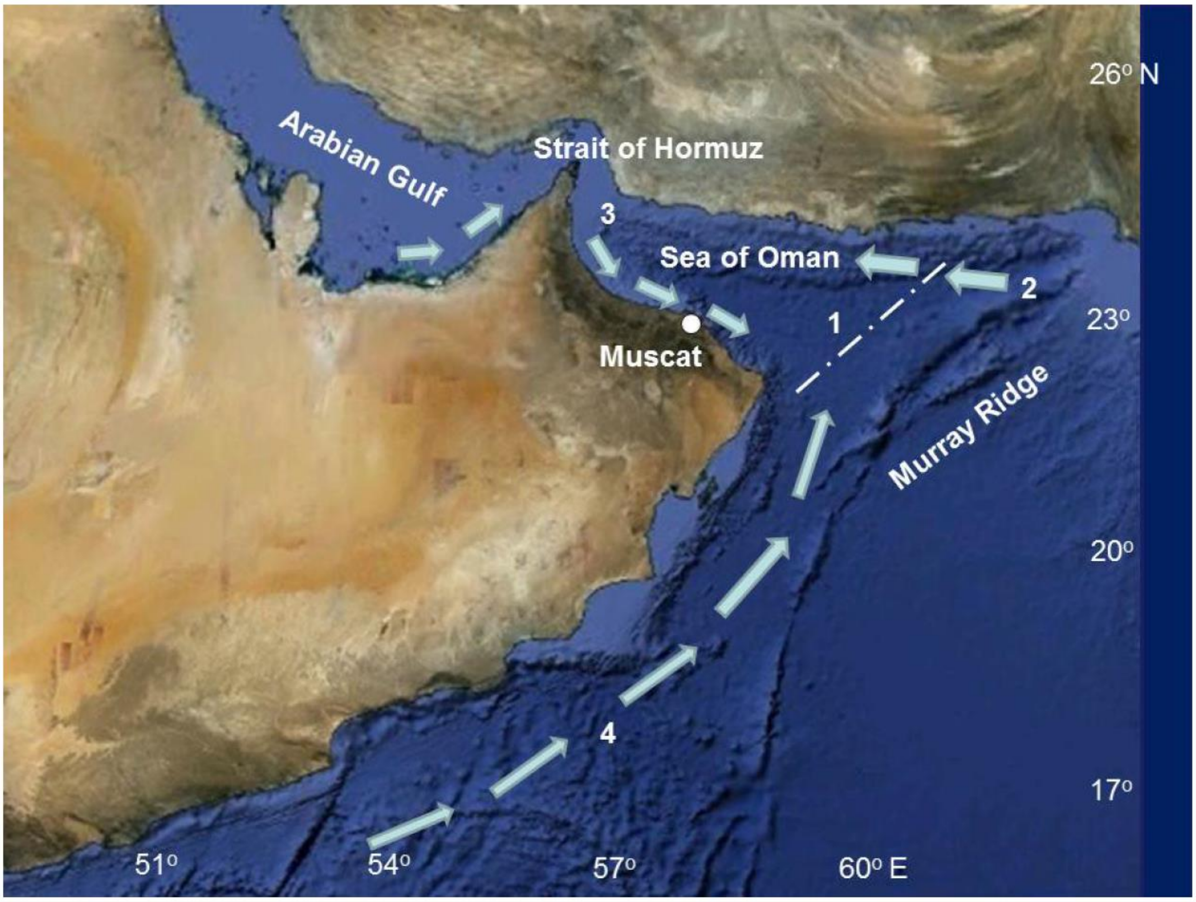
Table 5-1 Tidal levels at Sohar Port

Tide	Level (m above MSL)
Highest Astronomical Tide	1.40
Mean High Water Springs	1.00
Mean High Water Neaps	0.45
Mean Sea Level (MSL)	0.00
Mean Low Water Neaps	-0.50
Mean Low Water Springs	-0.95
Lowest Astronomical Tide / Chart Datum	-2.00

Source: Deltares 2019a

5.1.4 Currents

On a larger scale, the waters of the Oman Sea are subject to strong seasonal variability in terms of both meteorological and oceanographic conditions. Winter months are characterised by the northeast monsoon conditions and the transport of Arabian Sea water heading from oceanic regions in towards the Arabian Gulf. During summer months, water movements in the Oman Sea are driven by the outflow of highly saline water from the Arabian Gulf towards the western Indian Ocean, at depths of approximately 100m (Piontkovski et al., 2012).



Source: Piontkovski et al., 2012

Note: (1). Dashed lines (2-4) indicate direction of the main currents (in summer through fall period). (2): inflow of the Indian Ocean Water mass. (3): outflow of the Arabian Gulf water mass, and (4): Oman Coastal Current.

Figure 5-3 The Sea of Oman region. Dashed and dotted line demarcates the location of the Ras Al Hadd frontal zone

Currents offshore of Sohar Port are driven by wind and tidal influences, with seasonal differences observed on this smaller scale. During winter months (January – April), surface currents flow in a south easterly direction, in line with the movement of the Arabian Gulf water mass. During summer months (May to October), surface currents are generally reversed and are visible flowing to the northwest, with an average velocity of approximately 0.07 m/s and a maximum monthly-averaged speed of 0.13 m/s (Deltares, 2018a; WSP, 2019). Currents recorded deeper in the water column (at depths >10m below MSL) are more evenly distributed and consistent with the prevailing wind conditions each month (WSP, 2019).

5.1.5 Coastal Geology

As described in the section describing terrestrial geology, the geology Sohar Port is located on the Al Batinah coastal plain which extends from the Hajar Mountains in the west, to the Oman Sea in the east. The Al Batinah plain is dominated by late tertiary to quaternary fluvial deposits which extends from the mountains to the sea (WSP, 2019). Thick limestone sequences on the western flanks of the Hajar Mountain range and underlying Semail ophiolite on the Hajar Mountain's eastern flanks are now exposed as a result. The ophiolite sequence is an important component of the coastal geology; this sequence includes the deposits of various minerals and metalliferous ores that contain high concentrations of chromium, nickel, copper and other associated elements. Consequently, trace elements commonly occur as a mineralogical component of marine sediments of the Batinah coastline, formed by erosion of the Hajar Mountains and conveyed along wadi beds into the marine environment during periodic storm and flooding events. Such sediments subsequently contribute significantly to the composition of marine sediments found at the coast and seabed in this part of the country.

The nearshore area of the Batinah plain surrounding Sohar Port is relatively flat, with extensive gravel plains, interspersed with low dunes and low rocky outcrops. Further inland, a Neogene sedimentary basin is located, with sediments belonging to the Fars group and younger alluvium (WSP, 2019). Aeolian sands are present immediately adjacent to the landward side of the coast; these sands are intermingled with clay and silt deposits, with a thin veneer of beach sand that stretches along the foreshore (Halcrow, 2015).

5.1.6 Coastal Sediment Transport

Driven by reversing wind patterns, geomorphological processes along the coast, such as accretion and erosion, continuously occur along the existing shoreline resulting in a dynamic equilibrium. Direct wave action, sea level rise, human interference and the interception of littoral drift has interrupted the equilibrium resulting in a shift in the balance causing coastal erosion, whilst shelter from waves, slowing of currents and subsequent sediment settling and accumulation are the main causes of shoreline extension (i.e., accretion) (WSP, 2019).

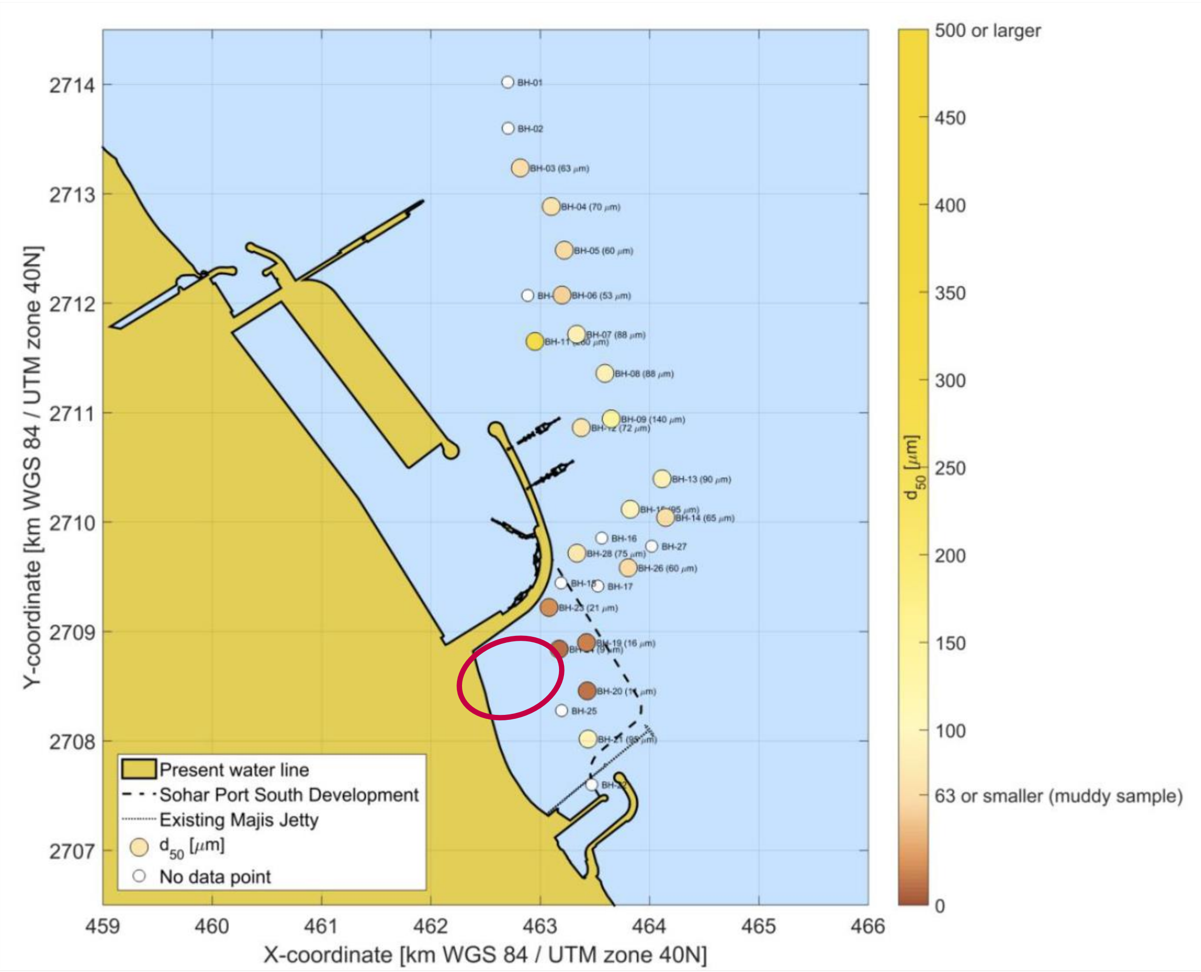
The shoreline around the port is an active area, with sediments actively stored, transported and exchanged (Kwarteng et al., 2016; WSP, 2019). Based on the limited tidal range and wind driven currents that characterise the area sediment transport in the project area is expected to be moderate, and mainly restricted to the surf zone with an estimated littoral drift of <100,000m^3 annually (Al Hatrushi, et al., 2014). All beaches have reflective upper shores and broad tide-dominated terraces (i.e., dissipative sand flats) on the lower shores (WSP, 2019).

Previous studies that have investigated morphological and hydraulic effects in and around the port indicate that long-shore transport is northwards at a rate of between 8,000m^3 and 13,000m^3/year (Deltares, 2007; WSP, 2019). More recent modelling studies and analysis of historic data identified the start of erosion associated with the construction of the port of the northwest coastline and accretion in the southeast coastline after the construction of the southern and northern breakwaters in 1999 (Deltares, 2008). Further erosion of the coastline around the northern village of Harmul was also shown by the model; but due to the placement of large volumes of beach sand in 2007, the effects were temporarily mitigated (WSP, 2019). The greatest barrier to longshore transport of sediment are the breakwaters of the port and the contribution of the land reclamation is considered to be negligible (WSP, 2019).

5.1.7 Marine Sediment Quality

Often as an element of environmental impact assessment studies for different port development projects, several sediment quality surveys have been conducted in the Project area in recent years. Particle Size Analysis (PSA) was carried out on samples to determine the composition of sediments (grain size, type, degree of sorting etc.), which yields information on the hydrodynamic conditions to which sediments are exposed in the sampled areas. Environments with lower wave energies usually result in smaller particle sizing, with the variability at sampling sites over time indicated by the degree of sorting (Blott and Pye 2001).

Results from 2015, 2017 and 2019 sediment surveys determined that sediments in the general Project area were strongly dominated by sandy sediments of fine to very fine sizes, with varying content contributions of gravel, medium sand and fine sediments such as silt and clay (Halcrow, 2015; Fugro, 2017; Deltares, 2019b; WSP, 2019). Survey results from 2015 (Halcrow, 2015) classified the sediments as “moderately to well-sorted fine or very fine sand (2 mm to 63 µm)” within the proposed reclamation area, which has been confirmed by more recent surveys (Fugro, 2017; WSP, 2019; Deltares, 2019b). The fine grained but sandy nature of sediments in the Sohar Port area indicates that the potential for suspension and wide scale dispersal is lower than would be the case if finer sediments (i.e., muds, silts or clays) were more dominant throughout the area. Unexpectedly, finer fractions were identified closer to shore (i.e. within the proposed reclamation area; see Figure 5-4; but since these sediments are buried under the proposed reclamation on which the plant will be built, these sediments will remain in place indefinitely. In undisturbed areas, finer sediments would be expected further offshore due to the sorting effects of wave energy arriving at the shoreline and the ability of fine sediments to settle and remain undisturbed in deeper water, so the pattern observed can only be explained because of movement of sediments by man, in this case i) the discharge of large quantities of fines during the original construction of the port ii) the placement and subsequent erosion of material dredged from the port basin in subsequent expansion of the port basin, and iii) the creation of a wave shadow when the seawater intake structures were built to the south of the port's southern breakwater. It has also been noted that sediments in the vicinity of the port are relatively unconsolidated in nature, and are therefore susceptible to disturbance and erosion (WSP, 2019).



Note: The red circles shows the estimated location of the Project.

Source: Deltares, 2019b.

Figure 5-4 Overview of surficial sediment characteristic of the mean sediment grain size (D_{50})

In addition to grain size analysis, sediment quality analysis was also carried out during previous surveys, with analysis and interpretation of the trace element component of marine sediments. During the most recent survey carried out in the Sohar Port area (WSP, 2019), arsenic, nickel and cadmium were found to be enriched above expectations in surface sediments at all sampled sites indicating a likely geological cause. Other anomalies were also noted, but could not be explained. As described in Section 5.1.4, ophiolite occurring in the watershed draining into the project area is expected to be the source of these elements and the elevated concentrations of arsenic, cadmium and nickel are consistent with the presence of ophiolite-derived erosion products in the marine sediments. Interpretation of the chemical analysis is confounded by the analytical methods used during the 2019 survey not being able to distinguish contamination from mineralogy of the parent rocks (WSP, 2019). Similar results are obtained from soil analyses conducted on undeveloped land in the SIPC concession area and in the Sohar Free Zone, which further indicates a geological origin to much of the trace element concentrations observed in the general area around the port and indeed along the Batinah coastal plain (WSP, 2019).

5.1.8 Seawater Quality

As part of the SPS Expansion EIA, a marine environmental baseline survey (MEBS) was undertaken in June 2019 (5OES, 2019), which included seawater quality analysis at several locations around the project site. Due to the "snapshot" nature of seawater sampling and the natural variability of seawater historic seawater sampling efforts are not discussed here.

Seawater quality in the Port area is considered to be good with respect to physico-chemical parameters and trace element composition (WSP, 2019). Laboratory analysis of seawater detected the presence of aluminium, arsenic, barium, boron, iron, lead, lithium, molybdenum, silver and zinc in trace amounts, as expected for natural seawater. Boron and lithium were detected similar concentrations to, or slightly lower than the reported average for these elements in natural seawater (WSP, 2019; 5OES, 2019).

Petroleum hydrocarbons were not detected in any of the seawater samples taken during the 2019 survey. The biological oxygen demand (BOD) was less than 2 mg/l (the detection limit), indicating a lack of organic material (dissolved and particulate) and associated aerobic biological digestion. Chemical Oxygen Demand (COD) ranged from 8-18 mg/l, indicating the presence of non-carbon compounds which are oxidizable with a strong oxidizing agent. Fecal coliforms counts were also low, indicating a lack of contamination by sewage discharge or animal waste (WSP, 2019).

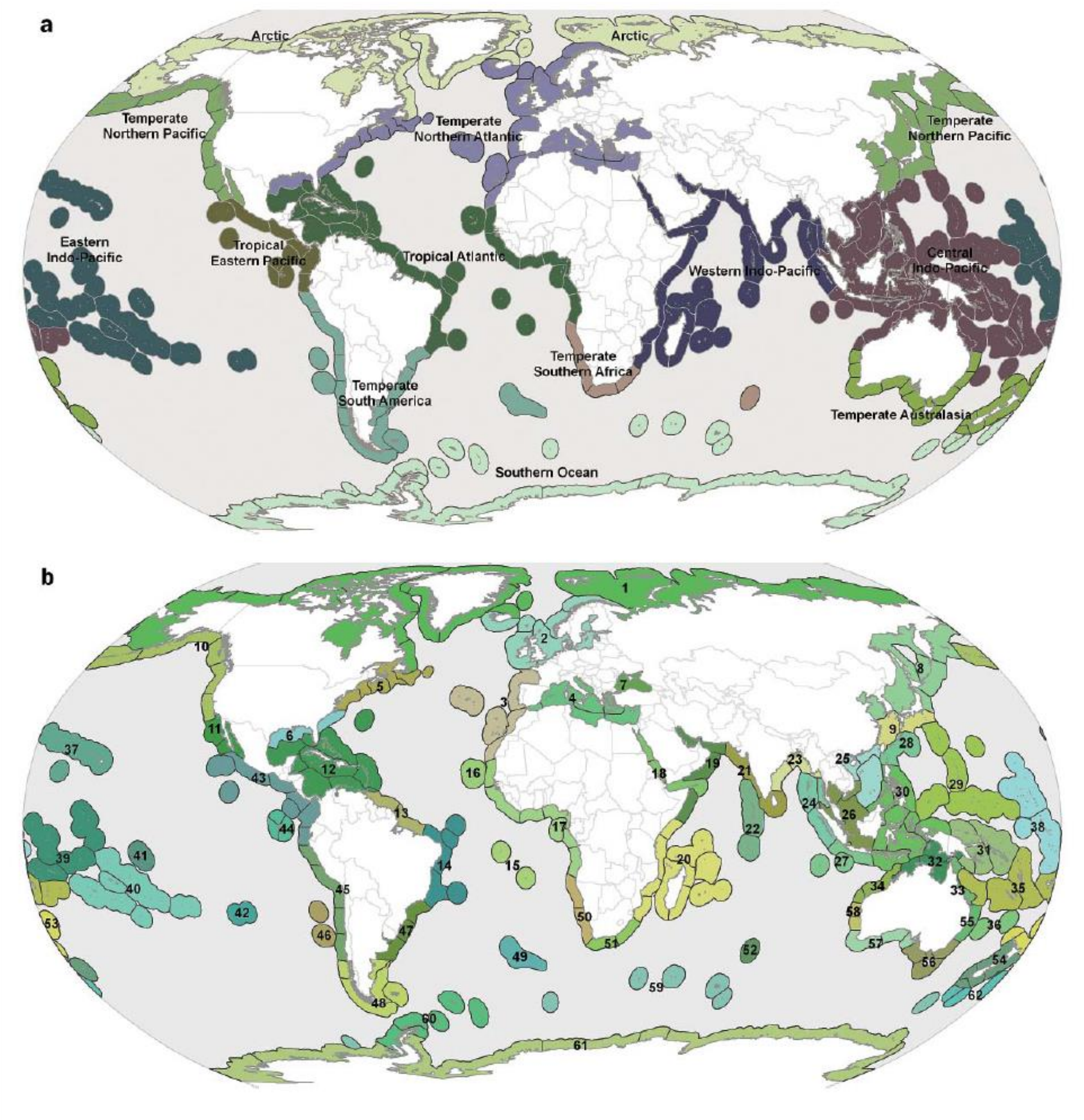
Turbidity monitoring during the Phase 1 reclamation showed that turbidity within the Sohar Port area typically fluctuates between 0.5 – 5 Nephelometric Turbidity Units (NTU), with short term spikes of up to 20 NTU (WSP, 2019), presumably caused by vessel movements or storm water runoff. An increase in 'baseline' turbidity was observed during the 2019 monitoring period, however it is of relevance to note that Sohar Port is an industrial working port, and some degree of sediment resuspension is to be expected from scheduled maintenance dredging and vessel movements.

5.2 Marine Ecology

5.2.1 Marine Habitats

A classification of marine ecoregions of the world by WWF (Spalding et al., 2007) places the Gulf of Oman ecoregion in the western Indo-Pacific realm (Somali/ Arabian province), and distinguishes it from the Arabian Gulf and the Western Arabian Sea ecoregions. The species found in this eco-region are a subset of those found in the Indian Pacific Ocean basin at large.

Figure 5-6 shows the map of biogeographic including: a) realms of internally coherent biota at high taxonomic levels and b) provinces of distinct biotas that interact over an evolutionary time frame.



Note: Western Indo-Pacific marine provinces include: 18 - Red Sea and Gulf of Aden; 19 - Somali/ Arabian; 20 - Western Indian Ocean; 21 - West and South Indian Shelf; 22 - Central Indian Ocean Islands; 23 Bay of Bengal; and 24 – Andaman.

Source: Spalding et al., 2007

Figure 5-5 Final biogeographic framework: Realms and provinces.

As part of surveys carried out in 2019, a side scan sonar (SSS) and drop-down video survey of the Sohar Port South expansion area and adjacent seabed was conducted. This showed that the seabed in the project area is generally a homogenous expanse of silty sand, with varying degrees of disturbance, infaunal burrows, pockets and ripples (5OES, 2019; WSP, 2019).

The construction of the port and associated hard substrates (wharfs, breakwaters, and jetties) has introduced new surfaces on which sessile organisms are able to colonise where previously only soft substrates occurred. Colonising invertebrates include species such as rock oysters, barnacles, sponges, ascidians, hydrozoans etc., which in turn provide habitats for small invertebrates such as shrimp, crabs, worms etc. that may be preyed upon by carnivorous fish (WSP, 2019). The presence of a fouling community with similar structure are common on artificial and natural hard substrates along the coast of the Oman Sea.

Due to the relatively high availability of nutrients, sunlight and other favourable oceanographic conditions, the water column is often capable of supporting sustained phytoplankton growth and subsequent primary production. Harmful Algal Blooms (HABs) are becoming more common in Omani waters, especially between January to May, when large blooms of the dinoflagellate *Noctiluca scintillans* are commonly reported from the coast of Khasab to Sur (Thangaraja et al., 2007; Goes, pers. comm.). Additional contributions to primary production are made by turf algae, present in shallow, well-mixed and oxygenated waters, and benthic phytoplankton such as diatoms, present on surface sediments within the euphotic zone, at depths where the sediments are generally undisturbed by wave movements but receive sufficient light (WSP, 2019).

5.2.2 Benthic Fauna

Benthic fauna is considered to be an important indicator of water and sediment quality and overall health of the marine environment. The measurement and analysis of abundance, diversity and composition of benthic communities allows some degree of monitoring to assess the overall health of coastal waters, and for any potential long-term trends in marine communities related to anthropogenic impacts to be followed. From an environmental monitoring perspective, the inclusion of benthic fauna offers three positive attributes:

1) They occupy an important intermediate trophic position
2) They are relatively sedentary and relatively long-lived
3) They respond differentially to varying environmental conditions.

The trophic position of benthic fauna in the marine food chain is an important aspect for the support of commercially important fish species, or for those to which a conservation value is attributed. Contamination of the marine sediments is likely to result in contamination within the food chain building up via the consumption of contaminated benthic fauna to the tissues of higher trophic level organisms. Certain species such as *Opheliidae, Neridae* and *Perinereis* sp. may be attributable as ‘indicator species’ to anthropogenic impacts when present in benthic communities with certain abundances and with pre-determined diversity indices etc.

There are several key variables that may influence benthic fauna community composition, including the grain size of the sediments present. This subsequently affects the depth of the anoxic layer, organic carbon content, anaerobic activity and the capacity at which contaminants may be adsorbed onto sediment particles. Disturbance frequency and intensity, such as storm events or routine dredging etc., also has an important impact on the community structure and sediment composition.

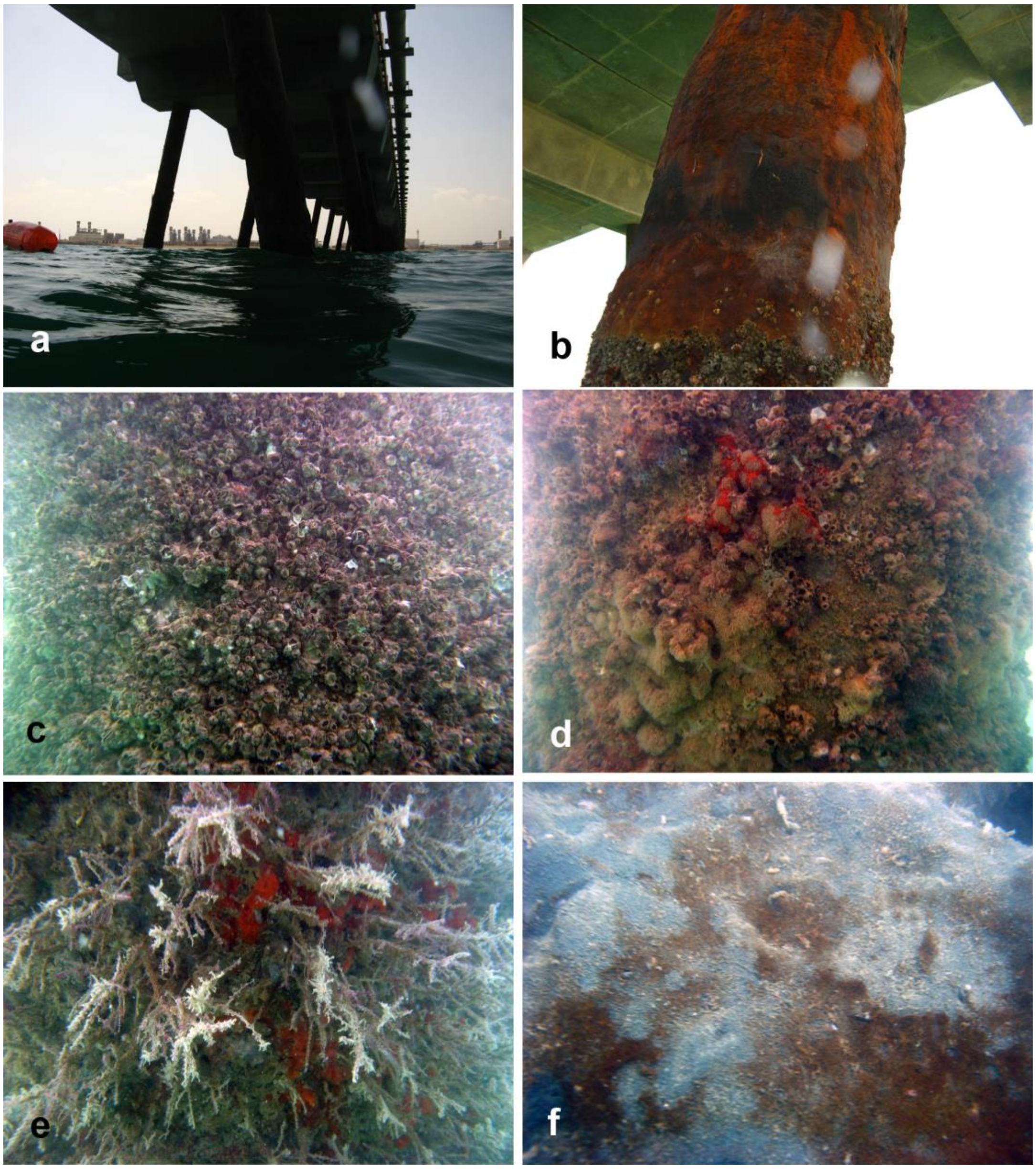
As part of the 2019 MEBS (5OES, 2019) conduced to inform the SPS Expansion EIA (WSP, 2019), sediment surveys included the sampling and analysis of 13 sites within the wider projected area for infauna. A total of 85 individuals were identified from 30 taxa, with Annelids dominating the community in terms of both the number of individuals (41) and the number of species identified. Analysis of the benthic infauna community recorded a community that was typical of the shallow water biotopes of the northern Al Batinah coastal region, although it was noted that the numbers of individuals collected during the survey were comparatively low, the community as a whole was relatively species poor and dominant species had a relatively uneven distribution across the site (5OES, 2019; WSP, 2019). For comparison, during a survey conducted in 2015, a total of 67 individuals were collected, comprising 24 taxa, from just 5 sites vs 13 sites sampled in 2019 (WSP, 2019).

A noted difference in the 2019 benthic fauna community when compared to the original baseline surveys for the port in 1999, was the apparent decline of the previously abundant gastropod *Strombus persicus* and the starfish *Astropecten* sp., neither of which were abundant or commonly observed during DDV footage of the seabed obtained during the 2019 MEBS (Atkins, 1999; 5OES, 2019; WSP, 2019). The feeding ecology of both of these species (the former is a grazer of the diatom layer, the latter as a deposit feeder or active infauna predator) is closely related to the characteristics of the surface sediments; changes in the sediment surface and characteristics are therefore suggested as the most plausible explanation for these apparent changes in abundance (WSP, 2019).

5.2.3 Artificial Hard Substrates

The Majis Jetty was last surveyed in 2016 survey (5OES, 2016); with communities unlikely to have changed significantly between then and the 2019 MEBS, which did not include an assessment of the survey (WSP, 2019). The jetty piles were colonised/fouled by sessile organisms including mixed barnacle assemblages (e.g. *Amphibalanus amphitrite*), hydroid species and bivalves. The seabed surrounding the piles was recorded to have few infauna burrows present, with a thin veneer of diatoms on the seabed (WSP, 2019).

Figure 5-6 shows colonising communities present on the Majis Jetty piles, as identified during the 2016 survey (5OES, 2016).



Note: a-b) Views of the jetty and corroded pile; c) Dense barnacle communities on the intertidal section of the pile; d) Mixture of zooanthid, barnacles, and sponge communities on the pile; e) Hydroid colonies together with red sponge; f) Substrate view on the pile locality, in some areas it is covered by a fine film of diatoms (5 m depth).

Source: 5OES, 2016.

Figure 5-6 Fouling Community on Majis Jetty Piles Figures

Breakwaters (northern and southern) within the wider port area were also subject to colonisation, particularly by urchins, algae, the rock oyster *Saccostrea cucculata*, barnacles (*A. amphitrite*), zoanthids (*Zoanthus* sp.) and other encrusting organisms such as sponges (5OES, 2016). Both the southern and northern breakwaters were recorded to support relatively diverse habitats when compared with the Majis Jetty piles, with the diversity at the northern breakwater higher than that of the southern breakwater. This supported the interpretation that the southern breakwater has been subject to a higher degree of disturbance since its construction, following cyclones in 2007 and 2010 compared to the northern breakwater, but with communities now showing signs of recovery (WSP, 2019).

5.2.4 Fish

Fish noted as present in the wider Sohar Port area during the 2015 jetty and breakwater assessments included: Black spotted butterflyfish (*Chaetodon nigropunctatus*), Pearly goatfish (*Parupeneus margaritatus*), Sergeant majors (*Abedufduf vaigiensis*), Picnic seabream (*Acanthopagrus berda*), Chromis (*Chromis* sp.), Snapper (*Lutjanus* sp.), Boxfish (*Ostracion syanurus*), Dotted bream (*Scolopsis ghanam*), Parrot fish (*Scarus* sp.), Goldband fusilier (*Pterocaesio chrysozona*), Cardinalfish (*Cheilodipterus* sp.) (5OES, 2016; with determinations based on Randall, 1995). Other species known to occur in Omani waters that may be present around permanent structures are generally considered to be reef fish, such as Squirrelfish (Holocentridae family), Scorpionfish (Scorpaenidae family), other Cardinalfish species (Apogonidae family), and coastal species such as various Fusilier species (Caseionidae family), Bream (Nemipteridae family), Seabream (Sparidae family), Goatfish (Mullidae family), Butterflyfish (Chaetodontidae family), Damselfish (Pomacentridae family) etc. (Al-Jufaili et al., 2010).

5.2.5 Marine Mammals

Cetaceans observed in Oman marine areas are documented in Baldwin (2003). Dedicated cetacean survey effort in the northern Al Batinah is limited although dedicated surveys have been conducted in Fujairah recently (2017-2019). The majority of observations of cetaceans in northern Al Batinah have come from incidental reports of beach cast animals and marine mammal observations made during offshore seismic surveys (Block 18, 1999, 2007 – 2010) located in the Oman Sea offshore from the project site in depths from 50 to over 1000 m.

The most up to date and comprehensive authority for the presence of cetaceans in Omani waters is the Oman Cetacean Database, which indicates 20 species of whale and dolphin have been recorded from Omani waters. The database was interrogated to identify species which have been observed within 50 km of Sohar Port, as well as species occurring in coastal waters up to 200 m depth in Al Batinah. The species list derived from this analysis, and supplemented with expert opinion, is given in Table 5-2 below.

When considering the homogenous, relatively featureless nature of the seabed along the Al Batinah coast, it is likely that cetaceans recorded in and around the study area are mostly likely to be transiting to other areas, or feeding on seasonally abundant pelagic fish, or other food resources associated with the continental slope and shelf (WSP, 2019). Cetacean activity close to shore (within 5 – 10 km of the coastline) is expected to be relatively low, however at least three species of cetaceans (Bryde's whale *Balaenoptera brydei*, spinner dolphins *Stenella longirostris* and bottlenose dolphin *Tursiops aduncus*) can be expected to occur in nearshore waters in the Sohar Port area from time to time (WSP, 2019). No cetaceans were observed during the 2019 MEBS undertaken in the vicinity of the Project area (5OES, 2019).

Table 5-2 Cetaceans expected to occur in coastal waters of northern Al Batinah up to the 200 m depth contour (from Oman Cetacean Database, 2020)

Common Name	*Scientific name*	IUCN status (2023)
Mysticetes (Baleen Whales)		
Bryde's whales	*Balaenoptera edeni*	Least Concern
Blue whale	*Balaenoptera musculus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Globally Least Concern (Arabian Sea Humpback Whale population: Endangered)

Common Name	*Scientific name*	IUCN status (2023)
Odontocetes (Toothed Whales and Dophins)		
Common dolphin	*Delphinus capensis*	Least concern
Risso's dolphin	*Grampus griseus*	Least concern
Spotted dolphin	*Stenella attenuata*	Least concern
Spinner dolphin	*Stenella longirostris*	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	Least concern
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	Least concern
Pygmy killer whale	*Feresa attenuata*	Least concern
Killer whale	*Orcinus orca*	Data Deficient
False killer whale	*Pseudorca crassidens*	Near Threatened
Dwarf sperm whale	*Kogia simus*	Least Concern
Sperm whale	*Physeter macrocephalus*	Vulnerable
Cuvier's beaked whale	*Ziphius cavirostris*	Least concern

5.2.6 Sea Turtles

In terms of marine turtle species, the most important species likely to occur in the vicinity of the project are the hawksbill (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*), listed by IUCN as Critically Endangered and Endangered, respectively (WSP, 2019). Loggerhead turtles (*Caretta caretta*), also an endangered species, have also been observed in these waters in low abundance.

Sohar is located on turtle migration routes, so is sensitive in this regard. Green turtles nesting in the large rookeries at Ras Al Hadd disperse to feeding grounds, which includes the extensive seagrass meadows and algal stands of the Arabian Gulf, particularly the shallow Southern Gulf waters of Abu Dhabi and Qatar, and therefore pass through coastal waters offshore Sohar where they may feed on any forage that is available. Hawksbill turtles, whose main nesting sites include the beaches of the Daymaniyat Islands and isolated pocket beaches on the mainland Omani coast, will generally disperse shorter distances than Green Turtles after nesting (Siddeek & Baldwin, 1996). Evidence from satellite tracking indicates that animals nesting at the Daymaniyat Islands will move northwards into the Gulf where they tend to forage on offshore oyster beds, or southwards into the Gulf of Masirah where they congregate around suitable feeding grounds. Loggerhead Turtles tend to migrate greater distances after nesting: females nesting in the globally important rookeries on Masirah Island have been shown to migrate into the southern Red Sea, into the Arabian Gulf, to the mainland coasts of India and Sri Lanka as well as south to the smaller islands of the Indian Ocean.

In terms of the vicinity of the project site, Hawksbill turtles are likely to forage on any hard substrate within the wider Project area, and may be part of the nesting population identified at the Daymaniyat Islands; a globally significant rookery (WSP, 2019). Green turtles are seasonally abundant in the Sohar area, with feeding preferences for ephemeral seagrass and algal communities; seagrass is not located in the project area, although two species were identified during the pre-construction baseline in 1998 (Atkins, 1999 cited in WSP, 2019). As indicated above, the project falls on the migratory path for hawksbill, green turtles and loggerhead turtles (*Caretta caretta*), the latter forming part of the nesting population on Masirah Island (Baldwin and Al-Kiyumi, 1996). Population estimates for the Sohar area are unavailable, but adults and juveniles are both likely to be present in shallow and offshore waters (WSP, 2019). There are no reports of nesting on beaches within the study area or vicinity, and beaches are therefore unlikely to be important in this respect (WSP, 2019). All turtles are legally protected under RD 114/2001 (Annex 1 and 2).

Table 5-3 Marine Turtles occurring in Oman (IUCN 2023, Baldwin and Al Kiyumi, 1996)

Common Name	*Scientific name*	Global IUCN status (2023)
Hawksbill turtle	*Eretmochelys imbricata*	Critically endangered
Green turtle	*Chelonia mydas*	Endangered (North Indian Ocean subpopulation; Vulnerable)
Loggerhead turtle	*Caretta caretta*	Vulnerable
Olive Ridley turtle	*Lepidochelys olivacea*	Vulnerable
Leatherback turtle	*Dermochelys coriacea*	Vulnerable

5.3 Marine Habitat Classification According to IFC Performance Standard 6

The purpose of this section is to determine if the project area contains species which trigger the need for a systematic critical habitat assessment (CHA), and if so, which species are the trigger species. This has been achieved by reviewing the definitions and requirements for CHA, reviewing the candidate trigger species occurring in the project area of influence and providing an expert opinion concerning whether the project area of influence should be considered critical habitat. This preliminary assessment forms the basis of the impact assessment on critical habitats to be taken forward in the impact assessment section of this report.

5.3.1 Definitions

A habitat is defined as a terrestrial, freshwater, marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment (IFC, 2012). According to IFC Performance Standard 6 (PS6), habitats can be classified as either modified or natural. Critical habitats are defined under PS6 as a subgroup of both natural and modified habitats. The definitions of these habitats are as follows:

- **Modified Habitat**: Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands.
- **Natural Habitat**: Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.
- **Critical Habitat**: Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered (either national or internationally listed) species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas

associated with key evolutionary processes. As per the definition, critical habitats are defined independently from natural or modified habitats (i.e. can be considered a subset of modified and/or natural habitats).

5.3.2 Area of Analysis

The scale at which a critical habitat determination takes places depends on underlying ecological processes of the habitats in question and is not limited to the footprint of the Project. PS6 Guidance Note (GN) 59 states that a project should identify an ecologically appropriate area of analysis to determine the presence of critical habitat for each species with regular occurrence in the project's area of influence, or ecosystem, covered by Criteria 1-4 (IFC, 2012). A more rigorous definition of the boundaries of this area still needs to be made that takes into account the distribution of species or ecosystems (within and sometimes extending beyond the project's area of influence) and the ecological patterns, processes, features, and functions that are necessary for maintaining them. For the purposes of this preliminary assessment a precautionary approach to defining a zone of influence has been taken, as described below.

The Project site fall into the Oman Sea marine ecoregion (Spalding et al., 2007) . When considering this preliminary assessment of the critical habitat the following should be noted, and borne in mind as these points limit the scope of what is possible at this stage of the environmental assessment:

- the appropriate spatial scale at which analysis should be conducted is difficult to define, and requires an assessment of the extent of an oil spill, the worst-case scenario with respect of risks to marine biodiversity;
- The spill risk arising from shipping is a shared risk, with the project's contribution adding incrementally to the cumulative risk; and,
- there is potential for large variations in range and mobility between species that may occur within the Project's area of influence.

The appropriate scale for a preliminary desk top critical habitat assessment is based on a precautionary area of influence in the marine domain. Based on available sources (see next section) a reasonable minimum area of analysis has been defined by a 50 km radius from the centre of the Project site. The scale of area of analysis is appropriate to capture marine habitat heterogeneity - which is considered relatively low, but which includes the depth gradient to 200 m contour line and beyond. Highly mobile species such as cetaceans, sharks and large pelagic fish are expected to move between deep and shallow areas so the spatial extent of the analysis will provide an adequate picture of biodiversity features that may potentially trigger the need to apply Critical Habitat guidelines.

5.3.3 Habitats within the Project Area

The near-shore marine benthic habitat is predominantly homogenous sediment consisting of sand and silt; natural hard substrata is uncommon (WSP, 2019). The sediments support a community of benthic infauna dominated by annelid worms (e.g., *Onuphis emerita*, *Sthenelais boa*, *Aonides* sp.) with some epi and in fauna that includes crustaceans and molluscs. Community composition is typical of other shallow sites along the Al Batinah coast, though there is evidence for a lower than average species abundance (WSP, 2019). Modified habitats are present in the form of ports, jetties, and a breakwater to the south, all which provide hard substrata. This habitat supports sessile invertebrates such as oysters (e.g. *Saccostrea cucculata*), barnacles (e.g. *Amphibalanus amphitrite*), sponges, sea squirts, and hydrozoans (WSP, 2019). Further offshore to a distance of 50 km from shore, the habitat is expected to continue being largely sedimentary, with the possibility of rock outcrops and ridges where benthic fish will occur at higher densities than in other areas. The pelagic environment in the project area is not considered unique, rather, it is typical of the oceanographic conditions in the northern Oman Sea.

As per the guidance notes for PS6, the potential presence of critical habitats should be evaluated based on criteria which include: the presence of floral/faunal species of conservation concern, endemicity and migratory behaviour, as well as the presence of sensitive ecosystems that are of conservation value or concern. In addition, as specified by PS6, the determination of critical habitat should include other recognised high biodiversity values, which are to be evaluated on a case-by-case basis, for example the presence of specific categories of national protected areas and internationally recognised areas.

5.3.4 Information Sources

IFC's recommended approach to data collection for critical habitat determination (GN 60) was used to establish the status of habitat present, which is outlined in the following steps.

5.3.4.1 Stakeholder Consultation and Literature Review

A literature review was conducted which drew on information from relevant authorities, academic/scientific institutions, other recognised external sources of information (e.g. Oman Cetacean Database, www.seaturtle.org which contains tracks of tagged turtles, IUCN Red list, key results of an IBAT proximity/PS6 analysis reports and expert opinion). The review included ESIA reports for projects in the vicinity including the Sohar Port South development project, and original data sources, papers and reports were re-visited in the context of the current project. Marine wildlife experts with extensive experience conducting research in the Oman Sea and Arabian Sea were also consulted concerning the presence and status of candidate trigger species.

5.3.4.2 Field-survey data collection and verification of existing information

No dedicated field survey data was collected for this Project as the existing data was deemed sufficient for the purpose of determining if critical habitat requirements applied to the Project. Two key sources of data were accessed for the preliminary assessment: the Oman Cetaceans Database and data held on www.seaturtle.org. The former database is managed by the Environment Society of Oman (ESO) and houses all records of cetaceans in Oman including where museum samples were collected, surveys conducted by ESO and other scientific research, and observations made by marine mammal observers during offshore seismic surveys. In the case of this project many of the offshore records for cetaceans were made during seismic surveys by qualified marine mammal observers. With respect to data held on www.seaturtle.org, the site houses satellite track data for turtles tagged anywhere in the world, which includes efforts in Oman and UAE. Satellite tagging in the region has mostly be conducted by marine wildlife scientists working under Emirates Nature-WWF and/or the Environment Society of Oman.

5.3.5 Limitations

The existing information used in this assessment has been verified by consulting marine wildlife experts with considerable research experience in the Oman Sea and who are members of IUCN Species Survival Commission Specialist Groups for Cetaceans and Marine Turtles. However, it should be noted that this section has been prepared based on available data from desktop sources. Potential critical habitats have been identified based on biodiversity resources (species/habitats/protected areas) that are known to occur in the project vicinity. Other trigger species which may occur in the project vicinity but have not been recorded or observed are included in the preliminary CHA but detailed information on their specific distribution and abundance in the area of analysis is not available so it was not possible to assess their status as critical habitat triggers with complete certainty.

5.3.6 IFC PS6 Criteria and Definitions

The term Critical Habitat is defined in Paragraph 16 of IFC Performance Standard 6, 2012 (PS6) as areas with high biodiversity value. This includes areas that meet one or more of the following criteria (Guidance Note [GN] 53, updated 27 June 2019):

- Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species;

- Criterion 2: Endemic or restricted-range species;
- Criterion 3: Migratory and/or congregatory species;
- Criterion 4: Highly threatened and/or unique ecosystems; and
- Criterion 5: Key evolutionary processes.

However, as specified by paragraph of GN53 of IFC PS6, the determination of critical habitat can include other recognized high biodiversity values, which are to be evaluated on a case-by-case basis. In the case of the current project, the marine area falls outside of both regionally determined areas (e.g., Important Marine Mammal Area, Important Marine Turtle Area (Pilcher, et al., 2014), Ecologically or Biologically Significant Marine Areas, EBSAs) as well as nationally determined areas such as coastal Special Planning Zone (SPZ), a designation created by the Oman National Spatial Strategy project. Consequently, only the five criteria listed above have been considered below.

5.3.7 Guidance by Criterion

5.3.7.1 Criterion 1: Critically Endangered and/or Endangered Species

Species threatened with global extinction and listed as endangered (EN) or critically endangered (CR) on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild. As per footnote 11 of Performance Standard 6, the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.

5.3.7.2 Criterion 2: Endemic and/or restricted-range species

IFC Guidance Note GN74 defines the term “endemic” as restricted-range. Restricted range refers to a limited extent of occurrence (EOO):

- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2. For comparison, the Oman Sea has an area of around 900,000 km^2
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).

5.3.7.3 Criterion 3: Migratory and Congregatory Species

IFC Guidance Notes GN76-77 define migratory and congregatory species in the following way:

- Migratory species:
  - Any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem).
- Congregatory species:
  - Species that form colonies (e.g., birds).
  - Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non-breeding purposes (e.g., foraging, roosting).
  - Species that move through bottleneck sites where significant numbers of individuals of a species pass over a concentrated period of time (e.g., during migration).

- Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed.
- Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species).

5.3.7.4 Criterion 4: Highly Threatened and/or Unique Ecosystems

The IUCN has initiated a program to develop a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The available guidance (GN79) states that where formal IUCN assessments have not been performed, assessments should use systematic methods at the national/regional level, carried out by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally recognized NGOs).

Bland et al. (2017) proposed the assignment of levels of threat to ecosystems at local, regional, and global levels (such as those used for species by IUCN) based on five main criteria:

	Criterion	Purpose
A	Reduction in geographic distribution	Identifies ecosystems that are undergoing declines in area, most commonly due to threats resulting in ecosystem loss and fragmentation.
B	Restricted geographic distribution	Identifies ecosystems with small distributions that are susceptible to spatially explicit threats and catastrophes.
C	Environmental degradation	Identifies ecosystems that are undergoing environmental degradation
D	Disruption of biotic processes or interactions	Identifies ecosystems that are undergoing loss or disruption of key biotic processes or interactions
E	Quantitative analysis that estimates the probability of ecosystem collapse	Allows for an integrated evaluation of multiple threats, symptoms, and their interactions

Source: Bland et al., 2017.

5.3.7.5 Criterion 5: Key Evolutionary Processes

The combination of environmental features in a region, such as topography, geology, soil, temperature, and vegetation, can affect the evolutionary processes that influence the configurations of species and ecological properties. In some cases, features that are unique to a landscape have been associated with genetically distinct populations or subpopulations of plant and animal species (e.g. Kok et al., 2012). Physical or spatial features have been described as surrogates or spatial catalysts for evolutionary and ecological processes, and such features are often associated with species diversification (GN81).

Guidance Note GN82 also provides the following examples of spatial features that are associated with evolutionary processes:

- Level of isolation (e.g., islands, mountain tops, lakes are associated with populations that are phylogenetically distinct.);
- extent of endemism (areas of high endemism often contain flora and/or fauna with unique evolutionary histories);
- spatial heterogeneity;
- presence of environmental gradients (ecotones produce transitional habitat which has been associated with the process of speciation and high species and genetic diversity);

- edaphic interfaces; and
- connectivity between habitats (e.g., biological corridors).

Criterion 5 is usually considered to be heavily reliant on scientific knowledge, and thus would be triggered in areas that have already been investigated or where of significant research results are available to indicate the potential or existence of unique evolutionary processes. Measurements and methods to identify evolutionary processes exist but are usually out of the scope of EIA studies. Thus a desktop review of available information for clues on the potential presence of such processes in the Project area has been conducted.

5.3.7.6 Criteria Thresholds

IFC Guidance Notes GN70 - GN80 detail thresholds of critical habitat, based on relative vulnerability (degree of threat) and irreplaceability (rarity or uniqueness). For Criteria 1 to 4, quantitative thresholds are provided and summarised in Table 5-4. Criteria 1 to 3 operate at species level, whilst Criteria 4 (and 5) concerns ecosystems and landscapes.

Table 5-4 Quantitative Thresholds for Application of Criteria 1 - 4

Criterion	Thresholds
1. Critically Endangered (CR)/ Endangered (EN) Species, or Vulnerable (VU) Species (GN71)	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species). (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a). (c) As appropriate, areas containing important concentrations of a nationally or regionally listed CR, EN or VU species.
2. Endemic/ Restricted Range Species (GN 75)	(a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.
3. Migratory/ Congregatory Species (GN 78)	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.
4.Highly threatened and/or unique ecosystems (GN 80)	(a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. (b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Source: IFC, 2019.

These thresholds rely on the availability of estimates of species global and local populations (e.g. either from published sources or via an in-field assessment in the case of local populations). Should this type of information be unavailable for any of the species under consideration, the assessor is expected to use expert opinion to determine the significance of the unit of analysis for CH determination with respect to the global population. Surrogates of population size (e.g., extent of occurrence, estimates of total area of known sites, estimates of area of occupied habitat) can support this process. In the marine environment, it is difficult to define units of analysis, which may further complicate the assessment.

Criterion 4 is triggered by ecosystems that are threatened, house unique assemblages of biome-restricted species, or are recognised for high conservation value, including protected areas. Qualitative categories and criteria from the guidance notes and from Bland et al. (2017) may be applied to evaluate ecosystem status if data exists to allow it.

Criterion 5 applies to landscape-level features that can influence key evolutionary processes. Key landscape features such as unique topography that creates unique habitats and areas important for climate change adaptations may be identified using literature review and through expert consultation.

5.3.8 Critical Habitat Screening

5.3.8.1 Application of Criterion 1

Taking species listed in Table 5-2 and Table 5-3 and combining it with data from Jabado et al. (2018) to identify CR, EN and VU species within the area of analysis (AoA) highlighted 13 marine species that could trigger the Project area and its vicinity to have critical habitat status (Table 5-5).

Table 5-5 Marine species potentially occurring within the area of analysis

Species	*Common name*	Status
Mammalia		
Megaptera novaeangliae	Humpback Whale	LC Global (EN ASWH sub-population
Balaenoptera musculus	Blue Whale	EN
Physeter macrocephalus	Sperm Whale	VU
Reptilia		
Chelonia mydas	Green Turtle	EN Global (VU NIO stock)
Eretmochelys imbricata	Hawksbill Turtle	CR
Chondricthyes		
Eusphyra blochii	Winghead shark	EN
Stegostoma fasciatum	Zebra shark	EN
Aetomylaeus maculatus	Mottled eagle ray	EN
Pristis zijsron	Green sawfish	CR
Rhincodon typus	Whale shark	EN
Rhina ancylostoma	Bowmouth guitarfish	VU
Rhynchobatus laevis	Smoothnose wedgefish	VU
Hemipristis elongata	Snaggletooth shark	VU

Notes; CR (Critically Endangered); EN (Endangered); and VU (Vulnerable).

Source: Oman Whale and Dolphin Database, seaturtle.org, Jabado et al., 2018, Andrew Willson, pers. Comm., IUCN, 2019; Minton et al., 2008; IBAT Proximity Reports). NIO = Northern Indian Ocean. ASHW= Arabian Sea Humpback Whale

5.3.8.2 Application of Criterion 2

This criterion was not deemed applicable to the project as, according to expert opinion, there are no known substantial populations of endemic or restricted range of marine species within the area of Analysis (AoA). For marine species this is typical and expected in an open section of shoreline and open water.

5.3.8.3 Application of Criterion 3

There is no known significant seasonal/permanent congregation of species within the AoA, nonetheless there is strong evidence of the existence of migratory pathways through the AoA which meet the conditions of Criterion 3. Migratory species include three species of turtles (Green, Hawksbill and Loggerhead Turtles), two species of cetacean (Humpback and Blue Whales) and one species of shark (Whale Shark), which are listed in (Table 5-5). Evidence for migration is based on tracks of animals fitted with satellite tags, and supported by other methods that allow the positions of individual animals to be known with certainty (e.g. photo-identification of spot patterns in the case of whale sharks or crenulations on tail flukes in the case of Humpback Whales). For other species listed in Table 5-5, such as the other species of sharks and the Sperm whale, they are considered to be non-migratory.

5.3.8.4 Application of Criteria 4

Marine habitats in the AoA, which consist largely of open areas of fine sand and mud are not highly threatened or unique indeed, their distribution is extensive. Furthermore, the risk of assets or activities associated with the project impacting them is very low, a point discussed in more detail later in this ESIA report. The area is not legally protected, nor is it considered as an Important Turtle Areas (ITA), Important Marine Mammal Areas (IMMA), of Ecologically or Biologically Significant Areas (EBSA) nor is it a coastal Special Planning Zone (SPZ). Criterion 4 is therefore not applicable.

5.3.8.5 Application of Criterion 5

There are no areas within the AoA that have a significant influence on key evolutionary processes. The topography of the seabed in the area is not unique, and the habitats encountered are common in the shallow coastal areas of northern Al Batinah. There are also no species that rely on specific regions within the AoA for key evolutionary processes. Therefore, criterion 5 not triggered.

From reviewing the applicability of criteria 1 to 5 in the AoA, a shortlist of species of high conservation value has been generated (Table 5-5). Shortlisting has been informed by Criteria 1 and 3 only, i.e., species that are EN, CR or VU and/or have the potential to use the AoA as a migratory pathway. The ecological context of each trigger species is given below.

5.3.8.6 Assessment per Species Identified

Blue Whale (Balaenoptera musculus)

The global population for mature blue whales is estimated to be between 5,000 – 15,000 (Cooke, 2018). Blue whales have been categorised into four subspecies, with the ‘pygmy blue whale’ being the most prevalent in the Arabian region (Baldwin, 2003).

At a regional level, population estimates are unclear, however, records have shown that blue whales could inhabit the northern Indian Ocean year-round with a geographic range defined by the Arabian Peninsula to the north, Maldives to the south and Sri Lanka in the southeast (Charles et al., 2012; Ilangakoon & Sathasivam 2012). A factor that may enable blue whales to reside in a comparatively limited range is the high productivity of the Arabian Sea which is crucial to sustain such a large creature. Blue whales are known to breed in the Arabian region with the majority of calves being born in April and November (Baldwin, 2003). The Blue whale is listed as Endangered (Cooke, 2018).

Since population status of the Blue Whale in the Arabian region are not available, it is necessary to judge whether Criterion 1 is met by following the three criteria given in GN72. The threshold of 0.5% of the global population represents a minimum of 25 animals, and it is considered unlikely that this number of animals would be present within the AoA at any time, based on the currently available information for this species in the region. This preliminary assessment therefore concludes that the AoA cannot be considered critical habitat for the Blue Whale.

Humpback Whale (Megaptera novaengliae)

The global population abundance of humpback whales is currently undefined by IUCN status assessments (Reilly et al., 2008), but is estimated at over 80,000 individuals. The most recent assessment of the Arabian Sea population in Oman indicates a population of Arabian Sea Humpback Whales (ASHW) of just 82 individuals (95% CI 60-111) and it has been speculated that this sub-population is in decline (Minton et al., 2008) with the main threats being incidental bycatch in the gill net fishery.

The IUCN Red list classifies Humpback whales globally as Least Concern. However, in the Arabian Sea research has determined that this species is essentially non-migratory although individual animals foray between Omani and Indian waters, and they are recognised by the IUCN Red List as being geographically, demographically and genetically isolated (Minton et al. 2008) and are referred to as the 'Arabian Sea humpback whale sub-population which is listed by IUCN as being **Endangered** (Minton et al., 2008).

Given the endangered status of the ASHW stock, and the very small population size, even a single mature animal (i.e. a reproductive unit) may represent an 'important concentration' of a nationally listed EN species. Humpback Whales have been recorded in the AoA and therefore Criterion 1 is met.

Sperm Whale (Physeter macrocephalus)

Sperm Whale habitat typically consists of marine waters deeper than 1,000 m (Taylor et al., 2008). When feeding conditions are favourable, sperm whales maintain relatively small ranges that are usually 10 – 20 km across. Where animals migrate animals travel at speeds of about 4 km/hr or about 90 km/day. Long-range movements have been reported by tagged females in the South Pacific, where females tagged for periods of over one month travelled on average 650 km (Best, 1979). Available data suggest periodic migrations of mature males between low latitude breeding and high latitude feeding grounds. Tagged males in the Southern Ocean showed average displacements of 1,600 km or about twice the value recorded for females (Best, 1979). There is no specific information in regard to Sperm whale migration routes along the Northern Indian Ocean, although it is likely that animals are resident in the region year round because of the availability of rich feeding grounds. Global population estimates for this species are estimated for the year 2000 at fewer than 380,000 individuals (Taylor et al., 2008).

Sperm whales were first known to occur in Oman from beach cast carcasses. Live animals have been reported in deep water off Muscat and off Fujairah, and in 2017 a carcass washed ashore near the Port of Sohar. Sperm whales are also known from Pakistani sector of the Gulf of Oman and Arabian Sea (Gore et al., 2007). According to WWF-Pakistan, the Arabian Sea is known to have a large population of oceanic squids including purpleback flying squid and rhomboid squids, therefore, it was likely that the sperm whales may dwell in Arabian Sea, as 80 per cent of its diet consists of large pelagic squids.

Considering the total lack of data in regard to the population dynamics of this species within the wider Indian Ocean (and specifically within the Gulf of Oman), together with its wide distribution range and unknown migratory patterns it is not possible to assess whether it triggers critical habitat under Criterion 3. The threshold number of individual animals to trigger critical habitat under Criterion 1 would be 1900 in the AoA, which is not realistic, and therefore the AoA is not considered as critical habitat for the Sperm Whale.

Green Turtle (Chelonia mydas)

At a global level it is estimated that there are around 90,000 adult female green turtles nesting each year (Spotila, 2004). Because sea turtles do not nest every year, this figure represents only one year's nesting stock. Given estimates of remigration rates of 3 years (Hirth 1997) to 6 years (Esteban et al. 2017) for green turtles, this suggests that the global population of adult females ranges between 270,000 and 540,000 individuals. Globally Green turtles are considered to be an endangered species.

In the Arabian region, index sites in Oman (around 6000 annual nesting females: Ross & Barwani 1982, Al Kindi et al. 2008), Saudi Arabia around 1,000 annual nesting females; Miller 1989, Pilcher 2000), and Yemen (around 8,000 annual nesting females; PERSGA 2004) provide an estimate of around 15,000 adult females nesting annually (Mancini et al., 2019), which indicates a total adult female population of around 45,000 to 90,000 in the Arabian Region.

Although the green turtle stock in the North Indian Ocean area is classified as Vulnerable (Mancini et al., 2019) it is also a migratory species so is a candidate under both Criterion 1 and Criterion 3. There are no detailed data on the dynamics of the Green turtle migration to and from nesting sites at Ras Al Hadd to foraging sites the Gulf (and also nesting sites in the Gulf to foraging sites in Bar Al Hikman), so it is necessary to rely on expert opinion to judge if this species triggers critical habitat requirements. Several factors have informed the opinion below: i) there are no nesting sites in the project vicinity, ii) there are no or very limited foraging opportunities in the vicinity of the project, therefore during migration animals will be passing through the project vicinity without dwelling to feed, iii) the size of the range of the northern Indian Ocean sub-population is large (estimated to be less than 1 million km^2) and the AoA is relatively small percentage of this range, iv) the AoA lies on a known migration corridor, evidence for which has been obtained from satellite tracking studies. Despite the AoA being located on a migration corridor, it is not considered critical habitat for Green turtles.

Hawksbill Turtle (Eretmochelys imbricata)

At a global level it is estimated there are close to 20,000 to 26,000 adult female hawksbill turtles nesting each year (Spotila, 2004). Based on estimates of remigration rates of 2.7 years (Richardson et al., 1999) to 5 years (Limpus, 2009) for this species, a figure for the global population of total adult females of between 54,000 to 130,000 has been calculated.

At a regional level, index sites in Oman (~600-800 annual nesting females), Saudi Arabia (~500 annual nesting females), Egypt (~500 annual nesting females) Sudan (~350 annual nesting females), and Yemen (~500 annual nesting females) point to some 2,450 to 2,650 adult turtles nesting annually (Spotila 2004), or a population of 6,600 to 13,250 adult females in the Arabian Region. The hawksbill is classified as Critically Endangered (Mortimer and Donnelly, 2008), and this status applies to regional stocks. The threshold number of Hawksbill Turtles in the AoA to meet ‘important concentrations’ i.e. 1% of the nesting population is 33 adult females, which his considered unlikely given the benthic habitats expected in the AoA are not prime feeding habitat for Hawksbill Turtles, and the apparent migratory link between the nesting sites at the Daymaniyat Islands and feeding grounds to the south off Bar Al Hikman. It is therefore considered unlikely that the AoA represents critical habitat for Hawksbill turtles.

Loggerhead Turtle (Caretta caretta)

The global population size of *Caretta caretta* has not been accurately determined, and there are uncertainties for the species global distribution data arising from a lack of data during juvenile and adult phases spent in the open oceans (IUCN). The most common proxy for population abundance in sea turtles is the annual number of nests. A total of about 200,000 clutches are laid annually by the 10 subpopulations altogether (see Table 2 in the Supplementary Material). Considering a range of 3 to 5.5 clutches per female, the above value would correspond to approximately 36,000-67,000 nesting females annually (Casale & Tucker, 2017).

Their geographic distribution In the North West Indian Ocean region ranges from Bahrain, Kuwait and Iran in the North and along the coasts of Oman, Yemen and into the southern Red Sea in the South (IUCN). Although population abundance estimates are also unavailable for this region, it is estimated that Oman hosts the largest *Caretta caretta* rookery in the Indian Ocean with an average of 64,500 nests being counted from 2010-2014 on Masirah Island (Tucker et al., 2013; Tucker et al., 2018), from which an estimate of 12,500 – 23,500 mature animals in the NE Indian Ocean sub-population (Casale & Tucker, 2017). Globally the loggerhead turtle is classified as vulnerable (IUCN), but the Northwest Indian Ocean regional management unit (RMU) is considered CR (Casale & Tucker, 2017).

If the global population of *C. caretta* is approximately 70,000 animals, the threshold for triggering critical habitat status in the AoA is 350, which is unlikely to occur in the area at any one time. What is known is that the main nesting sites on Masirah Island are approximately 650 km to the south east of the AoA in the Arabian Sea, and tagged females disperse in all directions from Masirah Island after nesting is complete, with only a small percentage of tagged animals migrating into the Gulf from Masirah Island. As stated above it is unlikely that 0.5% of the global population would occur in the AoA, and it is also unlikely that important concentrations would occur in the AoA. Subject to further analysis in a more detailed assessment this preliminary assessment finds that the AoA is therefore not critical habitat for the Loggerhead Turtle.

Whale Shark (Rhincodon typus)

Whale sharks are found in both coastal waters and open-ocean (Pierce and Norman, 2016). Approximately three quarters of the global population of whale sharks occur in the Indo-Pacific region, this population is estimated to have declined by around 60% in the last 75 years (Pierce and Norman, 2016). In the northern Indian Ocean whale sharks typically inhabit the Arabian Gulf area in the summer months (Robinson et al. 2017), with known aggregations in northern Qatar and there is emerging evidence for their migration along the coast of Oman (Robinson et al. 2017) through the waters of the northern Al Batinah via the Daymaniyat Islands to unknown feeding grounds elsewhere in the northern or mid Indian Ocean. Whale sharks are listed as EN by the IUCN (Pierce and Norman, 2016).

Although Whale sharks are a congregatory species, they only form aggregations under specific feeding conditions such as those described for the aggregation in northern Qatar which is thought to form during the spawning of tuna in the area on whose eggs the sharks feed. Minor aggregations have been reported in Omani waters and individual animals are landed by fishermen in Dibba (Musandam) and Muscat.

While no Whale sharks have been observed in the AoA to date (largely due to a lack of survey effort), based on the available information it is expected that a minimum of five adults may cross the AoA when migrating to and from the Qatari aggregation. While significant, it is unlikely that these numbers constitute 0.5% of the global population and therefore the AoA is not likely to represent critical habitat for Whale Sharks. It is important to note that this assessment is based on expert opinion only, as empirical evidence is lacking.

Other Sharks and Rays

Other potential candidate species expected to occur in the AoA include other species of sharks (e.g., Winghead shark, Zebra shark, Snaggletooth shark) a species of ray (Mottled eagle ray), a sawfish (Green Sawfish), the Bowmouth guitarfish and the Smoothnose wedgefish. However, insufficient information is available about these species in Oman or globally to be able to provide a fully informed opinion as to whether they might trigger critical habitat status. The status of these species is therefore considered a data gap and therefore within the limits of this preliminary assessment whether these species trigger critical habitat cannot be assessed further.

5.3.8.7 Summary of Critical Habitat Screening

In Section 5.3 the applicability of critical habitat criteria to the AoA has been reviewed which has generated a preliminary shortlist of trigger species under PS6 Criteria 1 and 3, as given in Table 5-6 below. This preliminary assessment provides a basis to assess the impacts and risks arising from the project and its associated facilities and activities in the project's area of potential impact. However, a great deal of uncertainty remains in the completeness of trigger species vulnerable to project risks however, the findings of the preliminary assessment has determined that trigger species certainly do occur in the vicinity of the project and that the impact assessment should consider if the trigger species are impacted or at risk of being impacted by the project. If there is no residual impact on these resources then a biodiversity management plan (BMP) will therefore need to be developed through engagement with SIPC as part of the environmental and social management plan (ESMP) but if there are significant residual impacts then a biodiversity action plan (BAP) will need to be developed that will set out biodiversity offsetting options and a system for demonstrating net positive gains on critical habitat and no net loss on natural habitats.

Table 5-6 Summary of Status of Marine CH Trigger Species

Species	Common name	IUCN status	Critical Habitat Triggered?
Megaptera novaeangliae	Humpback Whale	Globally Least Concern (Arabian Sea Humpback Whale population: Endangered)	Yes, under Criterion 1 (whenever a single animal is present in the AoA, which is highly likely on a seasonal basis)

6 SOCIAL, HEALTH, CULTURAL AND HUMAN RIGHTS BASELINE

6.1 Introduction

This section describes the baseline socioeconomic, health and human rights conditions relevant to the Project based on a combination of desktop and primary information collected during the field survey data collection engagement activities in November 2019 as well as a desk-based update conducted in July – August 2023 (refer to Section 6.2.3 below).

6.2 Methodology

6.2.1 Desktop Data Collection and Review

The desktop data collection process consisted of a synthesized account of various information sources and references primarily sourced from the following:

- Published literature including supporting grey literature (previous reports, existing studies, etc.) sourced from websites / data portals of the government, academic and research institutions, social organizations, etc.:
- Online government databases and statistical information in particular the Oman eGovernment Service Portal of the Sultanate of Oman[11] and the National Centre for Statistics and Information (NCSI)[12];
- Reports published by multilateral organisations;
- Non-technical literature (newspaper articles, etc.);
- References from previous ESIA studies that are publicly available for recent projects in the same geographic region.

The desktop information collected was mainly used to obtain contextual socioeconomic, health, and Human Rights information at the national and regional (Governorate and Wilaya) levels, but also includes limited AoI level information where available, mainly through the NCSI. Desktop research findings were presented in a Bibliographic Desktop Study prepared in October 2019.

6.2.2 Field Survey Data Collection and Assessment

A 9-day Field Survey was conducted from October 27th to 31st and November 3rd to 6th 2019 and was led by a combined 5OES/ERM team. The purpose of the field survey was:

[11] The official Oman eGovernment Services Portal of the Sultanate of Oman, provides the most significant and recent legislation and policies of various sectors, as well as latest ratification of international conventions. It also features key regulations and legislations that govern the work on eGovernment and the ICT sector in Oman. Much of the information on this website is in Arabic language. Thematic areas including links to various ministerial and institutional information in Oman are listed on this website, for Health and Sports, Housing and Planning, Labour, Justice, Environment, Educate and Research, Tourism, Agriculture and Fisheries, Water and Sanitation, Traffic and Transport, Social Service, Child and Family, Security and Anti-Corruption (refer to https://omanportal.gov.om).

[12] The National Centre for Statistics and Information was established in 2012 (Royal Decree 31/2012) with an aim of creating a national repository of information and statistical data on various themes of Oman's economy and development.
The Centre also provides indexes concerning to population and their structure at the various administrative levels in the Sultanate & has also displayed a reactive map showing institutions in both types, whether services sectors or trade sectors at the different levels of administration in the Sultanate and the possibility of pinpointing the required service or landmark, which are all available in the Informational Gate.(refer to www.ncsi.com)

- To collect specific socioeconomic, health, and human rights data at the local level to the extent available and at the Wilaya level; and
- To establish initial contact with key stakeholders in Muscat and Sohar and introduce the Project.

The data collection process was guided by the key issues and information gaps identified during the desktop review process and described in the Bibliographic Baseline Study prior to the field survey.

Data collection stakeholder engagement activities consisted primarily in Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and settlement profiling activities. This process was primarily qualitative in nature and the primary objectives of the social baseline data collection engagement activities were to:

- Briefly present the Project to stakeholders;
- Collect socioeconomic and health information at the settlement level to the extent available and at Wilayat level in order to collect more detailed information on specific issues identified during the scoping desktop review; and
- Document stakeholder opinions, questions, concerns and expectations to assist in defining the terms of reference and inform the scope of the ESIA.

Social baseline data collection engagement activities were conducted in accordance with the principles of engagement set out in the standards of MARSA LNG LLC and in line with Omani legislation, International Finance corporation (IFC) standards and good international industry practice.

These meetings included two separate meetings with the Walis of Liwa and of Sohar and other local government representatives to disclose basic Project information and collect feedback on the Project and request baseline data. Additionally, over 35 meetings with key governmental and non-governmental stakeholders at the national, regional and local levels were also organised.

Meetings held in Muscat during that same timeframe focused on national level stakeholders and included central ministry offices and relevant non-governmental organizations, while data collection activities in Sohar focused on regional and local level stakeholders including regional ministry offices, local government representatives, local community members and associations, expatriate worker representatives, and relevant public and private institutions.

National level data collection efforts continued after the field survey. Specifically, follow-up data requests were sent to the points of contact at the relevant ministries to collect more quantitative data on specific aspects.

At the local level, the social baseline data collection meetings were conducted as individual meetings with relevant local government ministry representatives (i.e. DG of Labour for Al Batinah North, Regional Office of Agriculture and Fisheries, Sohar Municipality, etc.) groups of non-governmental stakeholders (i.e. business associations, fishermen representatives, women's associations, etc.), and community members (i.e. fishermen and farmers).

At the start of every meeting a high-level introduction was provided to inform each stakeholder about the Project and the ESIA process. It was followed by a discussion on various topics, including but not limited to: community health, infrastructure and public services, livelihoods (agriculture and fishing), employment, worker issues, gender issues, cultural change, health and education, recommendations and opinions from those stakeholders met and a review of the follow-up data collection actions agreed. Among the concerns and recommendations provided, stakeholders indicated that their main concerns were related to the Project's impacts, benefits of the Project (employment) and recommended that engagement with stakeholders be continuous throughout the Project's lifecycle.

The results of the data collection stakeholder engagement meetings have been considered in the ESIA.

6.2.3 2023 Desktop Research

In July 2023, ERM conducted a desktop research (hereinafter referred to as the '2023 Desktop Research') of public information / media reports available in English and Arabic, seeking to understand potential changes that have occurred in the AoI, since the 2019 field survey (refer to Section 6.2.2 above), particularly related to:

- New industries in construction / operation in the Sohar Industrial Port Area; and
- COVID effects in the socioeconomic context characterising the AoI.

The 2023 Desktop Research was focused on Liwa and Sohar wilayas and particularly on the settlements considered to be more directly affected by the Project, which are deemed to not have changed compared to 2019 and to include: Majis, Ghadafan, Al Khuwairayn, and Falaj al Qaba'il. This 2023 Desktop Research has used the following key words and/or themes:

- Demographics: in / out migration, changes to the population, incoming workers, government resettlement, share of expatriate workers, changes to the ethnic / religious / gender structure;
- Land use and Tenure: changes in land use, farmers changing agricultural land to non-agricultural use, changes of agricultural livelihood patterns, changes to the residential profile, increases in cost of land;
- Pressure on housing, insufficient housing, increase of housing / rental prices, increase in demand of residential areas;
- New developments: new roads constructed, road safety, road conditions; water supply, water sanitation around the Sohar Industrial Port Area; water availability, water quality.
- New economic activities, changes in the economy of the area, new skills sets required/ available, inflation levels; employment / unemployment levels, youth unemployment, industrial sector in Sohar and Liwa, job composition;
- Skills sets available in Sohar and Liwa, skills sets required by the industrial companies in the Sohar Industrial Port Area;
- Socioeconomic development strategy, initiatives, projects around the Sohar Industrial Port Area, in Liwa, Sohar;
- COVID / pandemic in Liwa and Sohar wilayats, effects of the pandemic, changes to the health conditions, health issues;
- Worker camps / worker accommodation Sohar Industrial Port Area;
- Protests / demonstrations /strikes that have occurred;
- Fishing in Sohar, Liwa;
- Migrant workers, forced labour, child labour / young workers, human trafficking;
- Unpaid wage /Living wage/ Minimum wage/ Social insurance;
- Working hours, Working conditions and Exploitation;
- Injured / fatal accident /health and safety.

No additional desktop research of public (secondary) statistical information sources has been carried out. Therefore, the objective of this 2023 Desktop Research was not to fully update the baseline section, but to focus on key social aspects that are directly affected by the project, and that could have potentially changed. No engagement with external stakeholders has been conducted for the purpose of the 2023 Desktop Research. The 2023 Desktop Research provided information which has been used to update the remainder of Chapter 6 as well as, to the extent relevant, Chapters 7 and 8.6. However, as it could be anticipated, data was not available at settlement-level but more high level at wilayat or even regional level. Furthermore, the 2023 Desktop Research has not returned information on all target aspects searched such as: pressure on housing, companies closed due to the pandemic, prevalence of sexual transmitted infections, labour rights, harassment, hazardous work, recruitment fees, illegal workers, discrimination, freedom of religion.

6.3 General Context

6.3.1 National Context

The Sultanate of Oman is a monarchy ruled by His Majesty Sultan Haitham bin Tariq Al 'Sa'id since 2020. The Sultan presides over the Council of Oman, which comprises the Council of State (Majlis al Dawla), and the Consultative Assembly (Majlis al Shura). The State Council, equivalent to a Cabinet of Ministers, is appointed by the Sultan and is the body that determines Government policy. The Consultative Council (Majlis al Shura) is an assembly elected by the citizens and there are one or two representatives for each Wilayah, depending on the population size of the Wilaya.

In November 1996, the Sultan introduced a Basic Statute of State, effectively Oman's first written constitution. The law established a succession mechanism; set out the provisions for the development of the political and legal systems; and provided a blueprint for the direction of future economic policy.

The total estimated population in Oman for 2023 was of 4.9 million individuals (increasing from 4.6 million in 2018), with a population density of 15.01 km^2 on average. The population is mostly urban (85%) and almost half the population (41.90%) is composed of expatriates[13]. The last national census was conducted in 2020.

There are three levels of Government within the Sultanate of Oman: Central, Regional (or Governorate) and Wilayat. Details of the three levels are provided in section 2.2 of the ESIA.

6.3.2 Overview of Settlements in the Area of Influence

The Project social Area of Influence (AoI) includes the Project site and the surrounding area where potential direct impacts are expected to occur. As described in section 1.3 of this ESIA, the social AoI has been defined to include a total of 12 villages or settlements located within 2 km of the Port area, although focus is placed primarily on those villages that are potentially more directly affected by the development, namely Majis, Ghadafan and Al Khuwairiyah and Falaj al Qaba'il.

The list of AoI settlements and their administrative boundaries is presented in Table 1-1 of this ESIA. Figure 6-1 presents an overview of the main social characteristics of the settlements within the social AoI.

6.3.3 Local Decision Making

Settlements appoint a senior member of their community, the *Sheikh*, to represent them during engagements with Government and in relations with neighbouring settlements. Each *sheikh* is registered at the Ministry of Interior at department of Tribal Issues as the formal representative of the settlement or tribe. The *sheikh*'s' main responsibilities are to engage with the government through the Wali's office and make the community's case for aspects of social development or express grievance on behalf of the community. Minor disputes, such as petty crime, within the community are also referred to the *sheikh* for judgement and settlement.

The Wali is the senior Government representative of the Government in each *waliyah* and his main role is to communicate with the constituent communities through the *sheikhs* to enable other government processes such as planning, policy development and implementation to proceed with due consultation and consideration. He is an employee of the Ministry of Interior and serves for a period of three years in the waliyah to which he is assigned before being rotated to another assigned waliyah, a governance measure to ensure transparent and unbiased decision making.

[13] National Centre for Statistics and Information, available at eCensus Portal, accessed on 29 July 2023

Consultative Assembly (*Majlis Al Shura*) operates in parallel with the sheikh – Wali system of local government to provide an alternative channel for citizens to communicate with the government. *Majlis al Shura* representatives are elected by citizens with approximately one representative for each waliyah. *Majlis al Shura* representatives tend to be senior professionals already in government service, who perform their duty for three years. The role of the *Majlis Al Shura* is to ensure continual improvement in the delivery of government services in general and to allow the people's voice into heard in key Government decision-making processes.

Figure 6-1 Overview of Settlements in the AoI

Infrastructure and Services

Water for residential use is supplied through the municipal network. Irrigation water is taken from groundwater wells. In Falaj al Qaba'il irrigation water is sourced from the 'aflaj' systems bringing water from mountainous areas.
Wastewater is stored in sceptic tanks and collected by Al Haya company for disposal at the Wastewater Treatment Plants in Sohar and Liwa.
Solid waste is collected by Be'ah company.
All the settlements in the area are connected

Population

As of 2019, unofficial population estimates for Sohar settlements indicate that Majis and Falaj al Qaba'il has populations of 18,000 and 20,000 respectively. The combined population of Majis, Al Khuwairiya and Falaj Al Qabail alone is estimated at 47,000. The population increase is primarily attributed to the influx of both expatriate workers and Omanis from other areas. Expatriate labour are mostly located in Falaj al Qaba'il where two of the main labour accommodation camps are located, and in Al Khuwairiya where they represent 20 to 30% of the settlement population. Smaller numbers are also located in Majis and represent between 5% and 10% of the population. Updated 2023 population numbers have not been available for these settlements.

In contrast, the population in the settlements of Liwa have shown a clear decline in recent years with people moving out of the area either voluntarily in search of better farming and living conditions, or through government resettlement efforts. A resettlement project has been ongoing for the settlements of Liwa (from Ghadfan all the way to Hallat al Sheikh) and most of the population has already been resettled to the 'Madinat al Ahlam' (the city of dreams) in Liwa, located some 21 km north west of the Port. Expatriate workers who lived in these settlements and represented about 10% of the population have also been relocating to other areas to find new rental accommodation.

Education

Generally, at the Governorate level, 99.9% of children in North Al Batinah are enrolled in basic education as of 2018. Education attainment in coastal areas among fishing communities such as Harmul and Majis in the AoI is lower. In 2012, 30.4% of fishermen in the Wilaya of Sohar held secondary school diplomas. In Liwa, 27% held primary school diplomas while only 1.8% held secondary school diplomas.

Two higher education institutions are located in the AoI: The Sohar Maritime College in Majis and the Institute of Sharia Sciences in Al Khuwairiya. Three additional higher education institutions are located in Sohar and one in the Wilaya of Shinas approx. 40 km to the north. More than half of the schools North Al Batinah (70%) are within Wilayat Sohar, of which 42% are private schools: Majis: 1 primary school and 1 public school; Falaj al Qabail: 1 school offering primary and secondary grades, 2 early primary schools, and 1 primary school for boys; Al Khuwairiya: 1 early primary and 4 private schools; Ghadfan: 1 early primary and 1 secondary school for girls; Al Ghuzayyil: 1 early primary school.; Al Hadd: no schools.

Livelihoods

Despite the decline in traditional livelihoods since the establishment of the Port and in the past 10 years, fishing in particular remains an important livelihood and a primary sources of income for most of the population in the coastal villages of Harmul and Majis. Farming activities have been in decline due to groundwater salinity and increasing land value in the area, and agricultural activities in the area are mainly focused on animal husbandry which is mostly a supplemental source of income. Farming has been mostly replaced with public sector jobs and limited jobs in the private sector. However, in some settlements such as Al Khuwairiya farming remains the primary livelihood for farmer who are now forced to rent agricultural land in less affected areas to cultivate.

Health

Although air quality monitoring data collected by the Environmental and Health offices reportedly show that indicators are within acceptable limits, community perception is that air quality degradation attributed to industrial activities in the Port has contributed to increasing incidences of asthma and respiratory illnesses and allergies. Main health infrastructure in the area include public health centres in Falaj Al Qabail and Hallat al Sheikh as well as 3 private clinics. Additional private clinics and the Sohar hospital are located further away.

Source: ERM 2023

6.3.4 Local Governance

Due to Sohar's strong historical connections with the Royal Court, the Chairman of Sohar Municipality reports to the Chairman of Muscat Municipality: both Municipalities fall under the administration of the Diwan of the Royal Court. In general, municipalities are responsible for delivery of municipal services, such as urban planning, waste collection, street cleaning, recreational amenities, approvals for construction, and the collection of municipal revenues for example from taxes levied on building lease agreements and advertising. Liwa municipality, like all municipalities other than Muscat and Sohar fall under the mandate of the Ministry of Regional Municipalities and Water Resources. The system of waliyah is separate and distinct from that of the municipalities.

All Ministries operate regional offices in each Governorate. Ministries generally maintain their Northern Batinah regional offices in Sohar or nearby. Examples of Ministries with particular relevance to the Project area are as follows:

- The Ministry of Agriculture, Fisheries and Water Resources has a Director of Agricultural Development for Wilayat Liwa in Liwa.
- Ministry of Labour (formerly Ministry of Manpower), which is responsible for delivery of the country's Omanisation policy, so essential consultees for all local labour recruitment, they have an office in Sohar.
- Ministry of Social Development, which is responsible for ensuring that people with low incomes are supported with financial incentives to return to work when they are able, or qualified; all matters related to NGO establishment, including Omani Women's Association branches.
- Ministry of and Urban Planning. Responsible for land ownership and distribution issues, as well as local development plans in conjunction with the Supreme Council for Planning; and
- Ministry of Health. Responsible for delivery of primary health care, hospitals and health education.

6.4 Planning and Development

In 2011, the Government[14] launched the Oman National Spatial Strategy (ONSS) project with the aim to guide sustainable economic and spatial growth over the next 30 years.[15] The Regional Spatial Strategy for the Northern Al Batinah Governorate was launched in 12 May 2019.[16] A Comprehensive Master Plan for Al Batinah Coastal Area along with a Detailed Master Plan for the Greater Sohar Port Industrial Area and Liwa were also completed in 2019 on behalf of the Supreme Council for Planning.[17]

The supervision of the urban planning in the wilayat including matters related to provision of municipal services, maintenance of public sanitation, building permits, lease management, as well as some aspects of land use allocation, is managed by the Sohar Municipality (previously known as the Sohar Development Office or SDO).

Most development in the Al Batinah governorate is concentrated along the coastal areas, and a large number of growth centres and development projects focused in areas where economic activities and services are concentrated. The rest of the interior areas are sparsely developed with scattered rural settlements. The administrative structure within the Governorate also contributes to the urban-rural development split, as it separates the governorate into two primary areas: Al Batinah Coastal Plain and the inner Al Hajar Mountains.

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[14] The governmental institution responsible for planning and development in Oman is the Supreme Council for Planning (https://www.scp.gov.om/en/Page.aspx?I=6)

[15] https://www.scp.gov.om/en/Page.aspx?I=38

[16] https://www.atkinsacuity.com/success/oman-guiding-sustainable-economic-growth

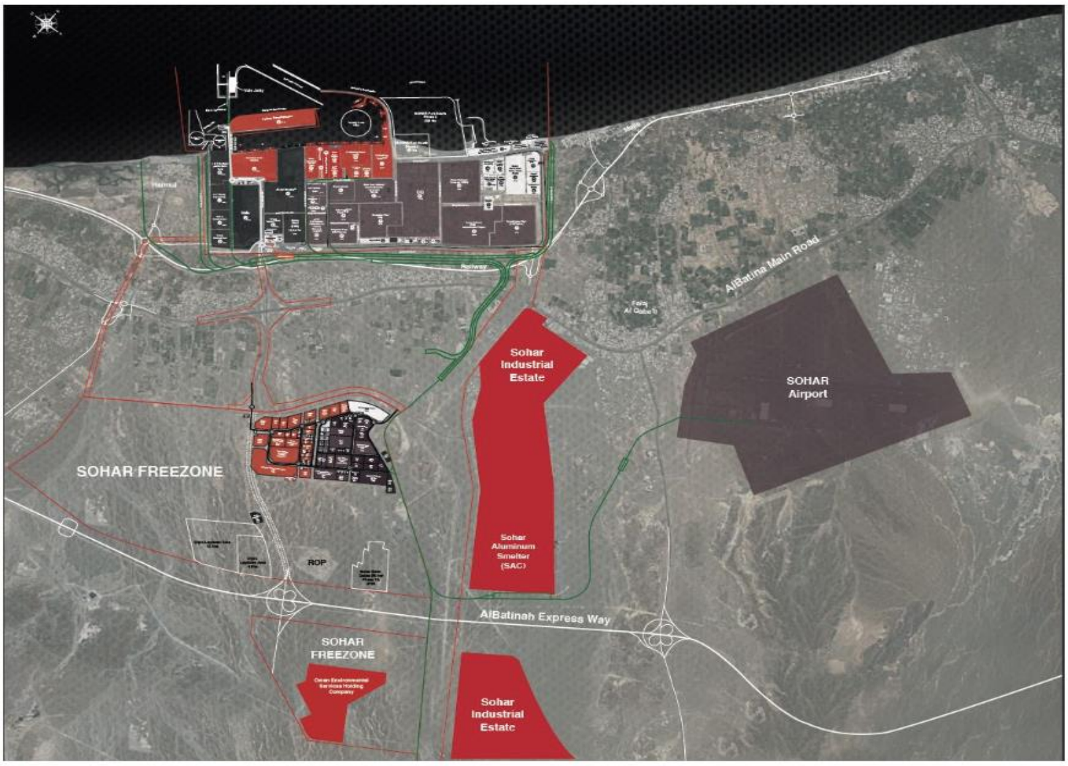
[17] http://www.lasaindia.com/details_page/preparation_of_a_comprehensive_master_plan_for_al-batinah_coastal_area_oman

The Sohar Industrial Port was built in the Coastal area of North Al Batinah. The port strategy established in 2011 aimed to convert Port Sultan Qaboos into a tourism port by shifting container, bulk and break-bulk traffic away from that Port to the Port of Sohar. The shift was completed in 2014. The expansion of the Sohar Port and corresponding expansion of its free zone as well as significant industrial infrastructure development (such as the common seawater cooling system now operated by Majis Industrial Services Company, MISC) led to rapid development of the industrial sector, mainly petrochemicals and metals, and related socioeconomic changes. Alongside the port and free zone expansion is a new airport expansion project, which will see an increase in both domestic and international capacity.[18]

According to the 2023 Desktop Research, the Sohar Industrial Port Area and its Freezone has experienced significant growth in all key areas. Land occupancy was 77% in 2022 and 14 new contracts were awarded[19]. By end of 2022, 52 countries were represented withing the Freezone. According to the CEO of Sohar Port and Freezone, the Sohar is planned to become an integrated industrial, logistics and port complex and a regional hub for many of Oman's major national industries.

The Sohar Freezone has attracted over US27 Billion in investments and was targeting further growth in 2023. According to the most recent information found on the Sohar Port and Freezone website, the first phase of the Free Zone has been developed, with almost 75% of the 500 hectares leased. Phase 2 is currently under way and will be developed in two phases, with construction commencing by the end of 2023. Production is estimated to commence by the end of 2024.

Figure 6-2 below illustrates the surroundings of Sohar Port and Sohar Freezone alongside Sohar Airport and areas for industrial development (industrial estates).



Source: Sohar Port and Freezone[20], 2023

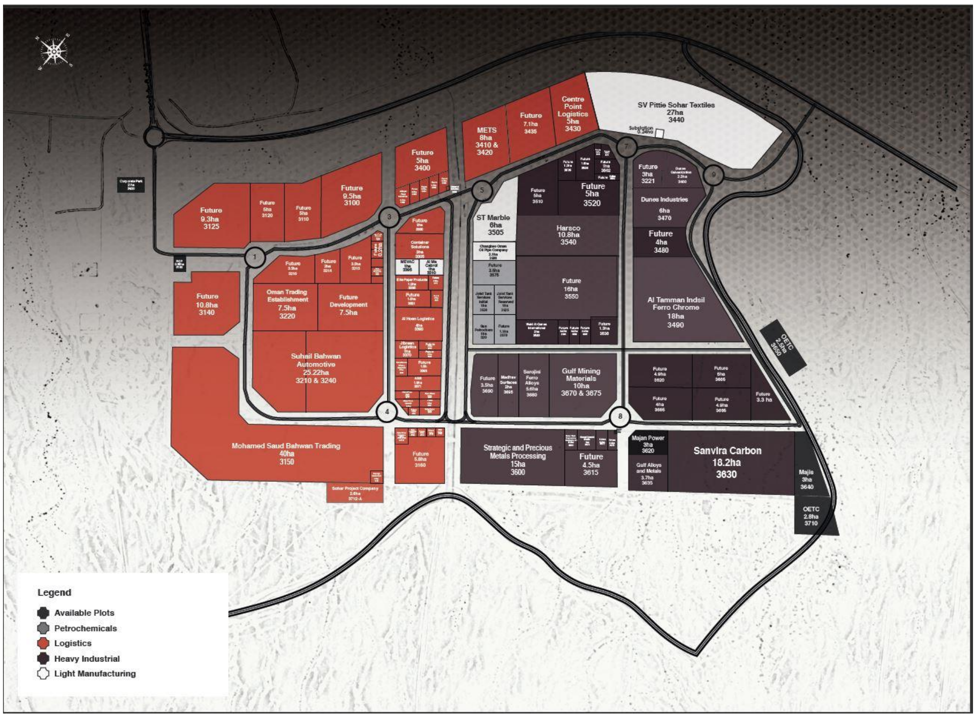
Figure 6-2 Surroundings of Sohar Port as of July 2023

[18] https://oxfordbusinessgroup.com/overview/prioritising-economic-and-logistical-development-across-governorates, accessed on 25 July 2023
[19] Sohar Port and Freezone announces impressive growth in all key areas - Times of Oman, accessed on 25 July 2023
[20] https://soharportandfreezone.om/en/soharport/portifno/sohar-gateway, accessed on 25 July 2029

Based on the 2023 Desktop Update, the following represents a list of new developments currently planned, under construction or in operations in the Sohar Port Industrial Area or Freezone since 2020:

- The Liwa Plastics Industries Complex: operational since 2021;
- Sohar Titanium Company (Titanium dioxide plant): located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in November 2022, under construction as of July 2023, operations expected to commence in 2025;
- A Petcoke Calcination Plant located in the Freezone area, around 10 km from Marsa LNG plot, which started its commissioning activities;
- Sohar Steel Rolling iron and steel manufacturing: located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in June 2022; construction has not started yet;
- Arkan Sohar Logistics Container Freight Station (CFS) and logistics complex (warehouse facility): agreement signed in 2022 but timeline of construction was unknown at the time of developing this report;
- Hydrogen plant at Sohar, inside the exiting Jindal Shadeed facility, which will decarbonize the steel production process of Jindal Shadeed´s iron and steel manufacturing plant; construction timeline unknown;
- GCC rail network in Sohar connecting Oman to United Arab Emirates: agreement signed in 2022; construction planned to commence in 2024;
- Trescorp oil storage and export facility: pre-feasibility stage;
- Sohar Port and Freezone Solar PV Park with a capacity of 975MW: pre-feasibility stage;

Figure 6-3 below illustrates the layout of the Sohar Port and Freezone as of July 2023.



Source: Sohar Port and Freezone[21], 2023

Figure 6-3 Sohar Port and Freezone Map, 2023

21 SOHAR Port and Freezone, accessed on 25 July 2029

6.5 Demographics and Settlements

6.5.1 National and Regional Population

This section provides an overview of the demographics in the Sultanate of Oman as a whole as well as in the Northern Al Batinah Governorate and in the Wilayas of Sohar and Liwa more specifically.

6.5.1.1 Population Overview

National level

As of 1 January 2023, the total population of the Sultanate of Oman was 4,933,850 individuals in 2020[22] (compared to 4,527,446 as of 1 January 2022). Approximately 62.10% of the population were male and 37.9 women. The population density was of 15.01 per Km^2. Oman Average Household Size data was 8.3 person in 2020[23]. The country population is relatively young; children (aged 0-17 years) account for 44% of the Sultanate of Oman's population and their number has risen by 16% between 2017 and 2021[24].

The key human development indicators for Oman with regards to demographics and life expectancy are presented in Table 6-1 below.

Table 6-1 Key Human Development Indicators for Oman

Human Development Indicator	Data
Sex ratio at birth (male to female births)	1.05
Urban population (%)	83.6
Young age (0-14) dependency ratio (per 100 people ages 15-64)	28.8
Old-age (65 and older) dependency ratio (per 100 people ages 15-64)	3.1
Net migration rate (per 1,000 people)	45.2
Life expectancy at birth (years)	77.3

Source: UNDP, Human Development Report, 2019[25]

Population growth in Oman has been strongly dictated by the growth of the expatriate population compared to natural growth rates of the Omani population. Data indicates that population in Oman increased by 1.5% between 2022 and 2023.[26] The largest foreign communities come from India and the Philippines, and represent more than half of Oman's labour force.

Regional and Local Level

In Northern Al Batinah Governorate, the population as of 1 January 2023[27] was estimated at 872,014 individuals with a sex breakdown resembling the national one: 60.7% male and 39.3% women. The population density as of 2018 (latest data available) was 96.3 per Km^2, much higher than the national average. However, non-Omani nationals in the Governorate represent over one third of the population (35%) compared to 41.90% at the national level. A decline in expatriate population is expected over

[22] National Centre for Statistics and Information, available at eCensus Portal, accessed on 29 July 2023

[23] 2020 Annual Health Report by the National Statistics Institute, Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

[24] 44 per cent of Oman's population under 17 - Oman Observer, accessed on 29 July 2023

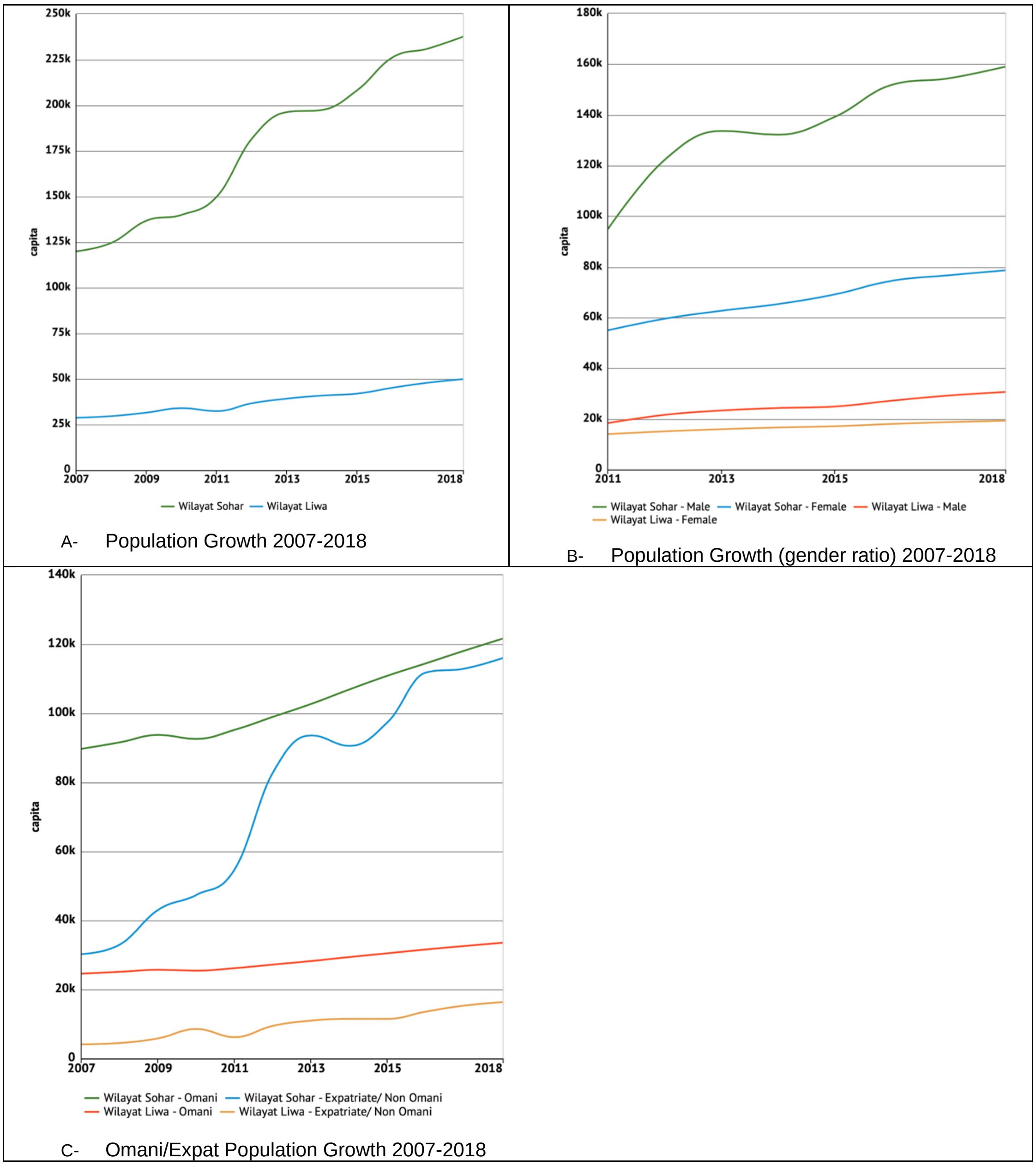
[25] http://hdr.undp.org/en/countries/profiles/OMN, accessed on 29 July 2023

[26] eCensus Portal, accessed on 29 July 2023

[27] https://data.gov.om/OMPOP2016/population?indicator=1000140&region=1000400-al-batinah-north&nationality=1000010-omani, accessed on 29 July 2023

the next few years due to the implementation of the Omanisation process initiated by the Government and the more recently implemented temporary visa ban for expats in specific occupations in the private sector as per Article 1 of Ministerial Decree 73/2019.

Population distribution in the Sohar and Liwa Wilayas are shown in Figure 6-4. Gender distribution follows similar patterns to those of the Governorate in both wilayas. This is mainly due to the fact that expatriate workers are mostly males.



A- Population Growth 2007-2018

B- Population Growth (gender ratio) 2007-2018

C- Omani/Expat Population Growth 2007-2018

Source: NCSI, 2019

Figure 6-4 Population Trends in Sohar and Liwa Wilayas (2011-2018)

According to the 2023 Desktop Research, the population was estimated at 269,900 individuals in Sohar Wilayat, with approximately 64.60% male (above the national level of 62.10%) and 52.30% expats (also higher compared to the national average of approximately 41.90%).[28] In Liwa Wilayat, the population was 63,296 as of 1 January 2023 and was characterised by 63.90% male ((above the

[28] eCensus Portal, accessed on 29 July 2023

national share of male) and 39.60% expats (below the national average).[29] In both Wilayats, the population is fairly young as, for example, only about 3% of the population in Liwa is above 50 years old.

6.5.1.2 Religion and Ethnicity

Religion in Oman

Islam is the primary religion in Oman with 85.9% of Muslims, and only 6.5% of Christians, 5.5% of Buddhists as per the 2010 census. Ibadism, a branch of Islam, is the dominant religion in Oman followed by Sunnis. While Shia Muslims constitute slightly less than 5% of Oman's population, they are well integrated into society.

The majority of non-Muslims are South Asian migrant workers who practise a variety of faiths, including Buddhism, Sikhism, Christianity and Hinduism. All religious organisations in Oman are required to register with the Ministry of Endowments and Religious Affairs. [30]

Figure 6-5 below shows mosques and burial sites observed in the AoI.

Notes: burial sites in located along Al Khuwairiyah road 2 km west of Majis settlement (top left) and Uqdat al Mawani settlement (top right); Mosques in Hallat al Sheikh (bottom left) and Harmul settlement bottom right)

Source: ERM Field Survey, November 2019

Figure 6-5 Religious Sites in the AoI

[29] eCensus Portal, accessed on 29 July 2023

[30] https://oxfordbusinessgroup.com/overview/desert-oasis-sultanate-becomes-regional-player-while-maintaining-rich-history-and-diverse-culture

Ethnic Groups and Tribal Populations in the Wilayat of Sohar and Liwa

Individuals from arab tribes of the Maqabeel, Bani ‘Umr, Bani ‘Issa, Ash Shibool, Ash Shizaw, An Nawafil, Bani Ma’an, Al Raheel, At Tawarish and many others still live and work in cities and suburbs of Oman. Principal tribes of the Liwa were historically located in the hinterland and include the Bani ‘Umar, Maqabeel, Bani Sa’ad, and Ar Riyaisah – an early faction of the Balush long established in the hinterland and no longer Balushi speaking. There are also some groups of Adh Dhahool, Al Ghafaylat, Bani Kharoos and Ash Shibool in the villages of the Wilaya.

Today tribal ties remain, but a high proportion of those in the mountains have moved permanently to the Al Batinah Coast, where medical facilities, schools, employment and good roads to other towns are more accessible. Tribal affiliation today is mainly an indication of identity, lineage and ethnic origins.

Most or all locals from the village of Al Khuwairiyah are from the same Tribe, the Al Jabri tribe, whereas most people from the village of Harmul in Liwa are from the Al Maamari tribe.

6.5.1.3 Urban and Rural Populations

Urban development in North Al Batinah Governorate primarily occurs in a linear pattern along the coast, over nearly 180 km long on a narrow strip of 7 km average width, sandwiched between the coast and the main highway. The areas located between the main highway and the mountains are either undeveloped or agricultural areas lacking sufficient infrastructure and road connection.

Urban development in the Wilayas of Northern Al Batinah Governorate is largely diffused, having scattered pattern and very low density. The main social facilities of the governorate, including hospitals and schools, are primarily concentrated in the Wilaya of Sohar. Sohar is the largest settlement in terms of population, economic activities, and infrastructure.

There is a general tendency in Sohar and Liwa towards low-density urban development, which is achieved by low, widely spread-out buildings. This resulted in an extensive roads network to supports urban sprawl. Commuting is mainly through private-car due to the lack of public transport networks that further increases the problems of energy use and pollution. The royal decree that grants every young Omani a piece of property, together with the rapid population growth, exacerbate the extensive urban and infrastructure sprawl.

In contrast, rural settlements in the Governorate are generally small settlements constituted of less than a dozen of households, and do not follow any planned spatial structure.

6.5.2 Population and Settlements in the Area of Influence

Based on 2010 census data, the total estimated population in AoI settlements was over 20,000 with approximately one third of the population (34.49%) composed of non-Omani nationals. This percentage reflects similar patterns as the governorate level. Further detail on the key demographic indicators for each settlement are summarised in Table 6-2 below.

Table 6-2 Area of Interest Settlements Population Indicators (2010)

Wilaya	Settlement	Tot. pop	Omani Population			Expatriate Population			Total Households	Omani Marital Status(%)			
			Tot. Omani	Omani Male	Omani Female	Tot. Expat	Expat Male	Expat Female		Not married	Married	Divorced	Widowed
Sohar	Majis*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sohar	Al Khuwairiyah*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sohar	Falaj al Qabail*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Liwa	Ghadfan	7,324	3,840	1,885	1,955	3,484	3,064	420	1,037	47.5	48.0	1.2	3.3
Liwa	Al Ghuzayyil	2,473	2,008	1,008	1,000	465	359	106	317	45.4	50.9	0.8	2.9
Liwa	Al Hadd	913	840	441	399	73	36	37	156	45.2	48.7	2.2	3.9
Liwa	Wadi al Qasab	1,680	660	334	326	1,020	1,001	19	116	39.2	55.9	0.7	4.2
Liwa	Uqdat al Mawani	1,526	1,104	557	547	422	383	39	238	49.1	48.5	0.8	1.6
Liwa	Al Mukhaylif*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Liwa	Hallat al Sheikh*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Liwa	Liwa	5,339	3,807	1,926	1,881	1,532	1,264	268	1,170	44.1	51.7	1.1	3.2
Liwa	Harmul	2,120	2,039	1,026	1,013	81	45	36	248	41.7	53.5	1.6	3.2

*Note: * Data not available.*

Source: NCSI, Census 2010

More recent demographic estimates were collected during the field survey. Based on these estimates, the combined population of Majis, Al Khuwairiya and Falaj Al Qabail alone is estimated at 47,000 whereas the total population in the area in 2010 was approximately 20,000. This population increase is primarily attributed to the influx of both expatriate workers and Omanis from other areas. The population estimates as of November 2019 are summarized in Table 6-3 below. However it should be noted that these numbers do not represent official census data.

Table 6-3 Population Estimates for Sohar AoI Settlements (2019)

Settlement	Total Population	Expatriate Population
Sohar Wilaya		
Majis	18,000	1,800 – 9,000
Al Khuwairiya	9,000	2,000
Falaj Al Qabail	20,000	6,000 – 7,000

*Note: *Population estimates for the AoI settlements in Liwa could not be obtained during the field survey (see limitation section in SBS main document).*

Source: ERM Field Survey, Focus Group Discussion (FGD) with sheikhs from Sohar settlements, November 2019

In contrast, the population in the settlements of Liwa have shown a clear decline in recent years with people moving out of the area either voluntarily in search of better farming and living conditions, or through government resettlement efforts. A resettlement project has been ongoing for the settlements of Liwa (from Ghadfan all the way to Hallat al Sheikh) and most of the population has already been resettled to the 'Madinat al Ahlam' (the City of Dreams) in Liwa, located some 21 km northwest of the Port. According to the 2023 Desktop Research, the City of Dreams was officially inaugurated in November 2022[31].

Compared to 2010, population data available as of 1 January 2023 and presented in Table 6-4 below shows that the population in Liwa has increased approximately 4 times. This can be explained by the resettlement of people from Ghadafan village, whose settlement boundary is approximately 400 m from SIPC concession boundary to the City of Dreams as indicated above.

Table 6-4 Population of the AoI Settlements (1 January 2023)

Settlement	Total Population	Expatriate Population, (% and number of inhabitants)
Sohar Wilaya		
Majis*	NA	NA
Al Khuwairiya*	NA	NA
Falaj Al Qabail*	NA	NA
Liwa Wilaya		
Harmul	2,344	8,9% (208)
Liwa	21,641	60.2% (13,019)
Ghadfan	5,923	50% (2,961)
Al Ghuzayyil	2,668	26.1% (697)
Al Hadd	992	39.2% (389)
Wadi al Qasab	2,398	79.3% (1,901)
Uqdat al Mawani	1,396	24.9% (348)

31 Liwa residential city to open today - Oman Observer, accessed on 9 August 2023

Settlement	Total Population	Expatriate Population, (% and number of inhabitants)
Al Mukhaylif	1,838	23.2% (427)
Hallat al Sheikh*	NA	NA
TOTAL (based on population data available)	39,200	Average of 50%

Source: eCensus Portal, 2023

** Census results do not identify this locality, data not available*

6.5.3 Vulnerable Groups

A vulnerable individual or group is one that could experience adverse impacts more severely than others, or have a limited ability to take advantage of positive impacts, due to a vulnerable or disadvantaged status. Vulnerability is a pre-existing status that is independent of the Project but that could be exacerbated if existing sensitivities and coping mechanisms are not adequately understood or considered.

The following groups are anticipated to be more vulnerable than the 'general population':

- Expatriate workers in the Sohar Port area: These individuals will not have the same level of social and economic benefits and local support networks due to their condition of expatriates.
- Fishing communities, including:
  - Households with lower incomes and reduced access to savings or credit will be less able to cope with financial / livelihood changes;
  - Households with a high dependency ratio (i.e. numbers of dependents to the numbers of income earners).
  - Youth from fishing communities who generally demonstrate lower literacy rates and education attainment levels may face more challenges in finding employment opportunities outside the fisheries sector;
- Children as they are often reliant on older members of the household or community to access assets or resources. When a child is not adequately represented by an adult, or is from a low-income family, they may be vulnerable to exploitation within the community or workplace. According to the 2023 Desktop Research, the latest report by the National Centre for Statistics and Information flagged that the number of cases of abuse among children increased by 9,3% from 562 cases in 2020 to 584 cases in 2021. Muscat and Al Batinah North governorates accounted for 69% of the observed cases of child abuse. The most common types of abuse experienced by children are negligence (46%), physical abuse (30%) and others – unspecified (24%).[32]
- People who lack physical mobility or who have mental health issues may be vulnerable to changes and unable to participate in decision-making, or those with underlying health issues that may be more sensitive to environmental changes. According to the 2023 Desktop Research, the latest report by the National Centre for Statistics and Information flagged that in 2021, 22% of all people with disabilities in Oman are found in Al Batinah North governorate.
- Unemployed Omani youth: Especially, local youth from the area who may face competition with Omani nationals from other areas.
- Other vulnerable households: Low-income households, female-headed households, households with disabled or elderly dependents.

[32] 44 per cent of Oman's population under 17 - Oman Observer, accessed on 25 July 2023

The MoSD provides protection in the shape of support programs for vulnerable families and citizens. A general increase over time in the demand for social support was highlighted as being primarily linked to the changes in the economic environment in the area

6.6 Land Use and Ownership

6.6.1 Land Use

With the construction of the Port in the early 2000s, land uses in the area had shifted greatly from residential and traditional fishing and agricultural land uses which have significant historical and cultural ties to local communities into industrial land use associated with the establishment of the Port and the resettlement of the coastal villages further inland. Since then and increasingly in the past 10 years, the sale of agricultural land or the change of land use from agricultural to non-agricultural has been a growing trend. Increasingly, land use changes are from agriculture to residential uses with more and more farmers requesting to change their land-use in order to build rental accommodation and supply increasing population numbers, especially for expatriate workers or Omanis workers from other areas.

These changes have been motivated by a number of factors, including the significant increase in land values due to the continued development of the coastal area, as well as the loss of productivity of agricultural lands due to increasing groundwater and soil salinity levels.

No new land parcels of any type were granted in Sohar area in 2016 and limited land was granted in Liwa, mostly for residential purposes. Together the number of land parcels granted in Liwa and Sohar amounted to approximately 1% of total land grants for the governorate, which may indicate over saturation of land use of all types in these areas. See Table 6-5 below.

Table 6-5 Land Grants by type in North Al Batinah Governorate (2016)

Wilaya	Residential	Commercial	Res/Comm	Industrial	Agricultural	Government	Total
Sohar	0	0	0	0	0	0	0
Shinas	434	10	35	3	11	34	527
Liwa	24	1	3	7	0	13	48
Sahm	626	27	42	13	10	25	743
Al Khabura	352	11	10	10	3	47	433
Al Suwiq	1,385	1	84	27	3	64	1,564
Total	2,821	50	174	60	27	183	3,315

Source: Ministry of Housing, 2016

6.6.2 Land Ownership

6.6.2.1 Residential land

In the Sultanate, since the issuing of the Land Law in 1980, Omanis have been eligible to be granted free land from the government as stipulated in the Land Law 5/80 and more recently in Ministerial Decree MD5/2011.[33] According to MD5/2011 every young Omani is granted a piece of land of minimum 600-m^2, which can accommodate up to 360 m^2 of built up area with 60% plot coverage.

Expatriates are not allowed to own residential land in designated places per Royal Decree 29/2018 and tend to be limited to owning properties within integrated tourism complexes. Specifically, according to Article 1 of the Royal Decree, the ownership of real estate and land by non-Omanis is

[33] https://eservices.housing.gov.om/

banned in the following locations: Liwa, Shinas, Musandam, Buraimi, Dhahirah, Masirah, Dhofar (except Salalah), Jebel Akhdar, Jebel Shams.

6.6.2.2 Agricultural land

Ownership and access to agricultural land is usually obtained through three possible channels:

- Government granted agricultural land;
- Land obtained through inheritance; and
- Land purchase.

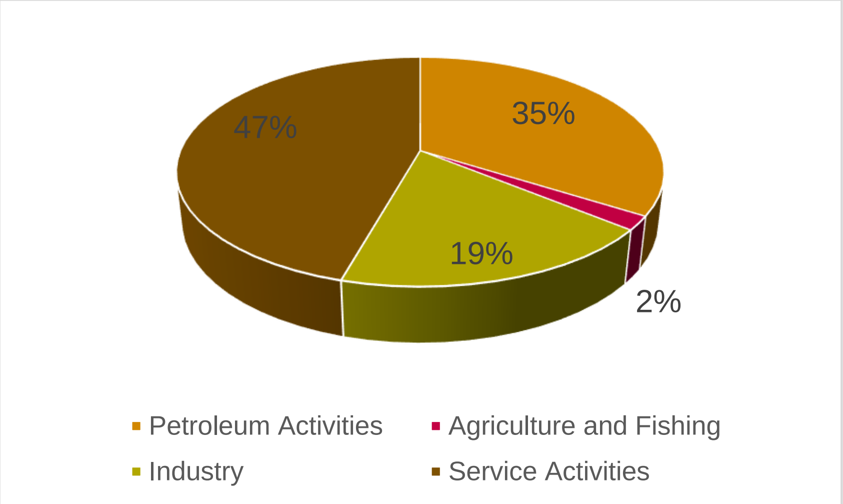
In the case of land granted by the government, farmers make a demand for a land grant through the Wali which is then processed in coordination with the Ministries of housing and agriculture. The size of the land granted is usually 10 *feddan* (4.2 ha). Today agricultural land is no longer given out in the AoI due to over-capacity and pressure on resources. Non-Omani citizens are not allowed to own land for agricultural purposes.[34]

6.7 Economy

6.7.1 National Overview

Oman's macro-economy is heavily dependent on its hydrocarbon sector, which account for 30% of Oman's nominal gross domestic product (GDP) in 2017 and rose in 2018 to 37.1%[35]. However, the share of petroleum activities in nominal GDP witnessed a decline in recent years, suggesting a modest decoupling of overall GDP from petroleum activities[36].

Oman's GDP was in 2018 as 79.29 billion of USD[37]. The structure of Oman's GDP is presented in Figure 6-6.



Source: Prepared by ERM based on data from the Central Bank of Oman, 2019

Figure 6-6 Structure of Oman´s Economy (% of GDP) in 2018

The GDP rose by 32% to 104.9 billion US dollars in 2022, according to official data from the World Bank. The GDP per capita was 21.96 thousands US dollars. [38]

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[34] https://www.omanobserver.om/restrictions-on-non-omanis-owning-lands-in-some-places/
[35] Central Bank of Oman, 2019. 2018 Annual Report.
[36] Oman Observer based on results of Central Bank of Oman Annual Reports.
[37] WorldBank, 2019. Oman Country Profile
[38] International Monetary Fund, IMF Data Mapper ®, accessed on 29 July 2023

Real GDP grew by 4.3% in 2022, primarily driven by a strong expansion of the hydrocarbon sector. In 2023, however, economic growth was projected to slow down to 1.3% and then to rebound to 2.7% in 2024. Nevertheless, non-hydrocarbon growth was projected to rise to 2% in 2023 and 2.5% in 2024, from 1.2% in 2022. Average inflation declined from 2.8% in 2022 to 1.6% during January-April 2023 (year-over-year), reflecting lower food inflation and a stronger US dollar.[39]

6.7.2 Human Development and Poverty

With a Human Development Index (HDI)[40] of 0.821 (in 2018 according to UNDP) and an Education Index of 0.603 (in 2013 according to UNDP), Oman is ranked 48 and 56, respectively, out of 189 countries and territories. Between 2000 and 2017, Oman's HDI value increased from 0.704 to 0.821, an increase of 16.6%.

The Table 6-6 below presents the key Human Development Indicators for Oman.

Table 6-6 Key Human Development Indicators for Oman (2017)

Human Development Indicator	Data
Health	
Life expectancy at birth (years)	77.3
Adult mortality rate, female (per 1,000 people)	68
Adult mortality rate, male (per 1,000 people)	107
Mortality rate, infant (per 1,000 live births)	9.2
Mortality rate, under-five (per 1,000 live births)	10.7
Child malnutrition, stunting (moderate or severe) (% under age 5)	14.1
Education	
Adult literacy rate (% ages 15 and older)	93.0
Gross enrolment ratio, secondary (% of secondary school-age population)	107
Gross enrolment ratio, tertiary (% of tertiary school-age population)	45
Population with at least some secondary education (% ages 25 and older)	66.4
Economy and Income	
Gross national income (GNI) per capita (2011 PPP $)	36,290
Gross domestic product (GDP) per capita (2011 PPP $)	37,961
Employment to population ratio (% ages 15 and older)	59.0
Employment in agriculture (% of total employment)	6.5
Employment in services (% of total employment)	55.3
Labour force participation rate (% ages 15 and older)	70.2
Labour force participation rate (% ages 15 and older), female	30.2
Labour force participation rate (% ages 15 and older), male	87.3
Unemployment, total (% of labour force)	16.0

[39] IMF Staff Concludes Staff Visit to Oman, accessed on 29 July 2023

[40] The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.

Human Development Indicator	Data
Unemployment, youth (% ages 15–24)	48.2
Gender	
Life expectancy at birth, female (years)	79.7
Life expectancy at birth, male (years)	75.6
Population with at least some secondary education, female (% ages 25 and older)	73.4
Population with at least some secondary education, male (% ages 25 and older)	63.7
Mean years of schooling, female (years)	10.4
Mean years of schooling, male (years)	9.2
Environment and Climate Change	
Carbon dioxide emissions, per capita (tonnes)	15.4
Fossil fuel energy consumption (% of total energy consumption)	100.0
Mortality rate attributed to household and ambient air pollution (per 100,000 population)	53.9
Mortality rate attributed to unsafe water, sanitation and hygiene services (per 100,000 population)	0.1

Source: UNDP, Human Development Report, 2018[41]

6.7.3 Governorate and local level

The North Al Batinah governorate, and more specifically Sohar[42] being the capital and largest city of the governorate, is considered to be one of the most important economic region of the country thanks to its high potential for foreign direct investments.

Sohar's role in the Omani economy is to become a business and industrial hub and help the Omani economy diversify away from oil, including renewable energies.

The port and free zone provides access to the neighbouring economies of the Gulf States while avoiding the additional costs of passing through the Strait of Hormuz. In addition, the existing road network that connects the Sohar Port and Freezone to Oman's main city such as Muscat and other cities such as Dubai, Abu Dhabi and Riyadh and airport as well as the future planned rail system provide direct connectivity to all GCC countries[15].

6.7.4 Economic Sectors

6.7.4.1 Oil and Gas

The importance of hydrocarbon sector in the economy remains critical for Oman's economy, despite increasing strategic focus on non-oil economic activities to promote diversification in the economy. However, since 2015 a decline of the average share of petroleum activities in Oman's GDP has been witnessed, suggesting a modest decoupling of overall GDP from petroleum activities.

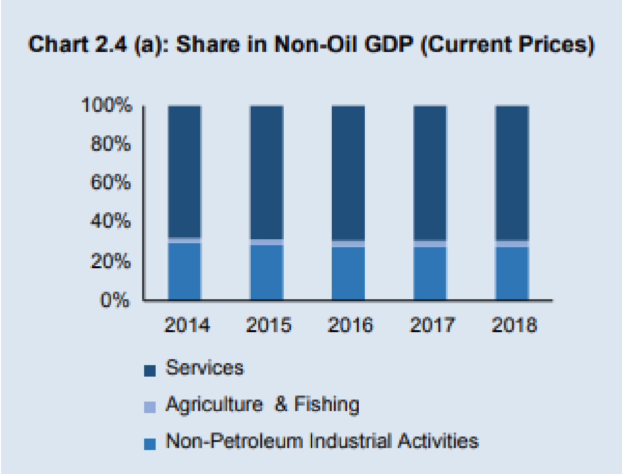
6.7.4.2 Non-petroleum sector

The non-petroleum sector is an up and coming important sector for sustainable development and generating adequate employment opportunities in Oman. Concerted policy efforts are underway to

[41] http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf

[42] Oman today has a number of major economic zones, which include Duqm Special Economic Zone Authority, Sohar Port and Freezone, Salalah Free Zone (BusinessliveME, 2019).

promote activities in the non-petroleum sector. The contribution of the different non-petroleum activities in Oman's GDP is presented in Figure 6-7 below.



Source: Central Bank of Oman, 2019

Figure 6-7 Share of Non-petroleum Activities in Oman's GDP (2019)

Small and Medium Enterprises (SMEs) play a critical role in the growth of non-petroleum activities for which the government and other stakeholders are currently endeavouring to nurture a strong SMEs sector.

It should be noted that there are six solar and wind projects planned for execution that would produce renewable energy up to 2.65 GW by 2024 and also contribute to other non-petroleum activities. The production of renewable energy would also save hydrocarbon resources for exports.

6.7.4.3 Mining

Oman's mineral resources include chromite, dolomite, zinc, limestone, gypsum, silica, copper, gold, cobalt and iron. In Sohar, the company Vale Oman, a subsidiary of Brazil-based Vale International, has given Sohar international exposure. It is a pelletizing plant and produces 9 million tons per year of direct reduction pellets and a distribution centre with capacity to handle 40 million tons per year[43].

6.7.4.4 Logistics and Transport

Alongside manufacturing, tourism, fisheries and mining, the transport and logistic services sectorhas been identified by the ninth Five-Year Plan (2016-2020) as a promising sector with regard to achieving. economic diversification and growth in the country
Sohar is emerging as one of the region's prime logistical hubs, in line with the government of Oman's Logistics Strategy 2040. According to customs import/export statistics, around 62% of Oman's total import in 2017 entered the country via Sohar Port, and around 42% of the exported volumes in 2017 were transported via Sohar[44].

6.7.4.5 Manufacturing

The manufacturing activities are accorded priority in the Omani Ninth Development Plan (2016-2020). Sohar plays an important role as a business and industrial hub. Manufacturing activities at the Sohar industrial area include:

- Aluminium industry with Sohar Aluminium Company established in 2004.

[43] Oman Mining Expo- https://www.omanminingexpo.com/about-the-oman-mining-industry.php
[44] BusinessliveME, 2019. https://www.businessliveme.com/economy/sohar-omans-gateway-to-growth/

- The Food Cluster whose objective is to promote the entire value chain of food processing and logistics support within the expanding multibillion-dollar regional food industry.
- SV Pittie Sohar Textiles' textile cluster (cotton yarn production unit No 1).
- The GCC's first glass recycling plant.
- Brazil's mining giant Vale pelletizing plant.

6.7.4.6 Fisheries[45]

Oman's extensive coastline of over 3,000 km is lined with fishery landing sites receiving catches of sardines, bluefish, mackerel, tuna, lobster, oysters and abalone from the Indian Ocean, mostly through traditional fishing but also from limited commercial trawling in the 400,000-km^2 exclusive economic zone waters it controls and regulates.

The fishery industry has a significant impact on the national economy and employment figure. According to the Ministry of Agriculture and Fisheries Wealth (MAFW)[46], fish is considered, after crude oil, the second most important export commodity in terms of foreign exchange earnings. Also, it is estimated that over 280 000 individuals derive some degree of income from the sector (considering that an Omani family unit is made up on average of seven people) (FAO, 2015).

Al Batinah Region contributed to 15.6% of the total fish production in Oman in 2016. Fishing capacity is growing gradually and consistently. In Al Batinah Region, fish production was doubled; as it increased from 21,852 tons in 2007 to 43,207 tons in 2016. The majority of fish landed by traditional fishermen in the Al Batinah region are large and small pelagic fish (accounting for approximately 80% of 2016 total landings) followed by demersal fish (accounting for 14% of 2016 total landings). Based on 2015 figures published by FAO, Omani vessels mainly fish in the Al-Batinah (north) and Al-Batinah (south). In 2012, these two regions accounted for around 25% of the active fishing boats, followed by Al-Wusta (20%) and Dhofar (19.95%).The number of fishermen and boats in the Sohar Wilayat amount to 2,830 and 1,058 respectively in 2016 while in the Liwa Wilayat it amounts to 2,098 and 871.

Although Oman's Al-Batinah coast accounts for almost 20% of the national catch, poor uptake of improved fishing technologies and practices, weak management, inefficiency and ineffective marketing have affected Al-Batinah fishermen to secure the lowest earnings among all fishermen in Oman (Al-Jabri, 2008). Currently, when other industries and jobs are unfolding to Omanis, retaining traditional fishermen in the sector will be crucial but challenging. Fishermen currently remain in this profession, either because of its growing profitability, or as a matter of habit (Belwal et al, 2010)[47].

6.7.4.7 Agriculture

The modernization of the agricultural sector and development of rural farms key pillars of Oman's Sustainable Agriculture and Rural Development Strategy (SARDS) towards 2040. Developed in October 2016, the vision of SARDS 2040 is to achieve 'a sustainable and profitable agriculture and rural sector contributing to the achievement of food security and Oman's overall development objectives'. SARDS 2040 focuses on increasing crop and livestock sectors' competitiveness, make farming practices more sustainable, specifically the use of natural resources, primarily water, and improving resilience of agricultural and rural livelihoods to climate change and natural disasters.[48]

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[45] MAF, 2016. 2016a Annual Report. Ministry of Agriculture and Fisheries Wealth (MAF). Sultanate of Oman

[46] The Ministry of Agriculture and Fisheries (MAFW) is the responsible management authority in the Sultanate of Oman for fisheries.

[47] 13) (PDF) Fishermen on Oman's Batinah Coast: A Lookout for Policy Interventions A Lookout for Policy Interventions. Available from: https://www.researchgate.net/publication/270890290_Fishermen_on_Oman's_Batinah_Coast_A_Lookout_for_Policy_Interventions_A_Lookout_for_Policy_Interventions [accessed Oct 23 2019]

[48] Government of the Sultanate of Oman, *Sustainable Agriculture and Rural Development Strategy towards 2040*, Final, October 2016, available at SARDS 2040 main document_final (unescwa.org) and accessed on 20 September 2023

Al Batinah is the main agricultural region of Oman, accounting for 50% of the country's agricultural production. The North Al-Batinah Governorate, where the Project is located, is considered to be the heart of agriculture of Oman, as well as comprising one of its largest industrial port and free zone.

Crop production depends entirely on irrigation, the main crops being dates, fruit crops, alfalfa, vegetables, and other forage crops[20]. The coastal sub-zone of the Al-Batinah region includes old date plantations of low productivity because of salinity. They are usually intercropped with other tree and forage crops. The Al-Batinah region faces challenges to improve the sustainable agricultural development, including (but not limited to):

- Extreme Climatic Conditions;
- Water Scarcity;
- Saline intrusion in Water and Soil[49];
- Urbanisation;
- Climate Change and Desertification;
- Fragmentation of Land Holding and Small Farm size; and,
- Subsistence Agriculture and Low Agricultural Productivity.

6.7.4.8 Tourism

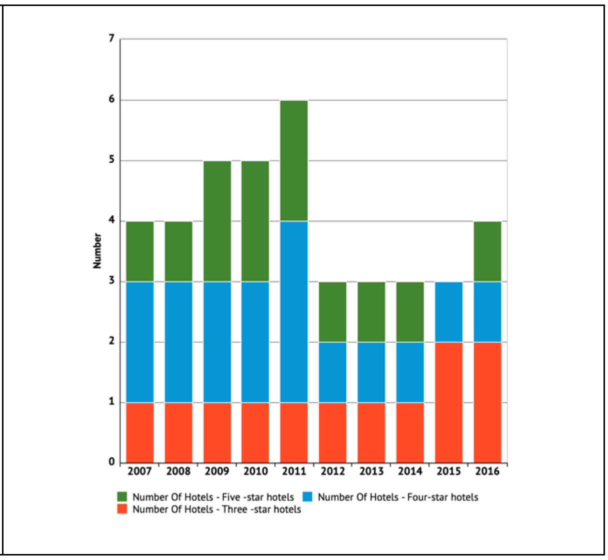
Oman has made progress over the years in establishing itself as a destination for tourism with numerous luxury and eco-friendly tourism projects emerging along the coast. In North Al Batinah, however, tourism investments have not been common, given the industrial / logistics land use and the lack of local heritage sites and natural features.

Although the Sohar area is currently identified to be an area of low tourist attraction, the wider area of North Al Batinah has been identified as a priority area for future tourism investment in the second phase of the National Tourism Strategy (NTS) which is expected to be implemented between 2026 and 2030.

Broadly, hotels in North Al Batinah have been operating at below national average levels of occupancy with an average occupancy rate of 44% between 2010 and 2016 - see Figure 6-8 below. However, in recent years, North Al Batinah recorded the second highest occupancy rates after Muscat, reaching 55% in 2015. This is attributable to a lagged impact of the high economic growth in North Al Batinah which has driven more visitors to the Governorate.

[49] Over pumping of water in the last couple of decades, has led to gradual seawater intrusion causing irrigation water more saline. As a result, several agricultural lands of the coastal areas have become unsuitable for cultivation.

Time	Number Of Hotels	Number of Guests
Units	Number	Number
2007	14.00	99,266.00
2008	14.00	175,805.00
2009	20.00	100,683.83
2010	22.00	124,726.75
2011	24.00	122,589.67
2012	16.00	104,292.00
2013	17.00	114,182.00
2014	18.00	179,120.00
2015	22.00	
2016	25.00	



Source: NCIS, 2017[50]

Figure 6-8 Number of Hotels and Guests in North Al Batinah

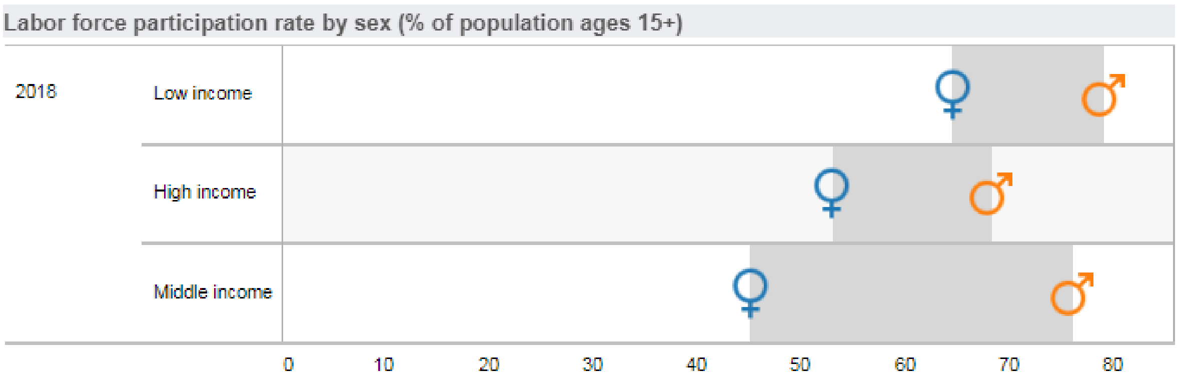
6.8 Income and Employment

6.8.1 Income

Oman's average monthly household income has seen an increase in the past years, rising by 21.5% between 2011 and 2019. According to a survey conducted by National Centre for Statistics and Information (NCSI), the income reached RO 1,173 ($3,062) compared to RO 965 ($2,520) in 2011.[51]

The percentage of pension pay, which 15% of Omani households depend on, recorded an increase by 15%, compared to 5.5% in 2011, according to the results of the Household Income and Expenditure Survey released by the National Centre for Statistics and Information (NCSI). The percentage of transfers and other sources of income also increased to 2.6 per cent, compared to 1.2 per cent in 2011.[52]

With regards to differences between gender in income level, Figure 6-9 presents the percentage of population, women and men aged 15+ and their income level in 2018 based on International Labour organization (ILO) estimates.



Source: World Bank Oman Gender portal based on ILO estimates, 2019

Figure 6-9 Labour Force Participation Rate by Gender

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50 NSCI Data Portal, accessed in 2019 for North Al Batinah region

51 [Average household income in Oman jumps by more than 21% (zawya.com)](), accessed on 29 July 2023

52 [Average household income in Oman jumps by more than 21% (zawya.com)](), accessed on 29 July 2023

6.8.2 Employment

6.8.2.1 Employment at the National Level

At a national level, the labour force is of 2.255 million based on 2016 estimates. The main employers within the different economic activities of the private sector of Oman in 2016 are: Construction (35% of workers), Wholesale, Retail Trade & Repairs, Vehicles motorcycles and personnel & household goods (15% of workers) and Manufacturing (12% of workers). Agricultural, hunting and Forestry employed 5% of workers in 2016. Hydrocarbon exploration and production companies employed up to 17,100 workers.

Since 1988 Oman introduced the policy “Omanisation” aimed at replacing expatriate workers with trained Omani Personnel. NCIS 2017 statistics show that there is a clear division between Omanis and Expatriates in terms of the types of employment with the majority of Omanis (92%) employed in the public sector, and the majority of expats (84%) employed by the private sector. It is understood that this is attributable to a number of factors:

- A preference among Omanis to be employed by the public sector arising from higher remuneration and benefits and more job stability;
- A skill mismatch between the needs of private sector businesses and the skills of the Omani population.

The unemployment rate at a national level decreased from 2.9% in 2020 to 2.5% in 2021 and 2.3% in 2022[53]. However, unemployment levels rose in 2023 when the National Centre for Statistics and Information (NCSI) indicated the national level unemployment rate was 5% in February 2023 and decreased to 4.10% in March 2023.[54]. The World Bank estimated youth unemployment among Omanis at 49% in 2019, making job creation an important challenge for Oman, for which the government continuously makes efforts to generate employment opportunities for its citizens which in turn relies upon reducing the number of foreign residents in the country[55]. A 2022 quoting of the World Bank indicated that unemployment remains higher among Omani youth aged between 15 and 24, and particularly among young women. It emphasised that more Omanis are currently employed in the private sector as compared to the pre-pandemic times. The private sector is the largest contributor to Omanis’ employment. After a decline in 2020, the number of Omanis employed in the private sector has bounced back, and as of December 2021, it is estimated at about 267,000 compared to an average of about 262,300 in 2019.[56]

In 2021, unemployed youth organised a 5-day protest across several cities in Oman. According to the 2023 Desktop Research, driven by high unemployment among youth protests broke out on May 23, 2021 in Sohar, the same city where Oman’s massive 2011 protests began. Many of Oman’s youth were demanding more than jobs: structural economic reform, social justice, and expanding powers of the elected Shura Council. Clashes were reported between police and protesters in Sohar. In order to contain the protests, Oman announced a plan to create 32,000 jobs in the public and private sectors.[57]

Protesters claimed that foreigners have better and more opportunities in the private sector than Omanis, even in cases in which Omanis are more skilled and have higher education. They argued

53 Oman Unemployment Rate - 2023 Data - 2024 Forecast - 1991-2022 Historical - Chart (tradingeconomics.com) and Unemployment, total (% of total labor force) (modeled ILO estimate) - Oman | Data (worldbank.org), accessed on 29 July 2023

54 Unemployment, a growing challenge in Oman (muscatdaily.com), accessed on 29 July 2023

55 The Arab Gulf States Institute in Washington, 2019. New Omani Initiatives Reflect Gulf States’ Psuh to Nationalize Labor Forces

56 Youth unemployment in Middle East twice as high as world, Oman fares better - Muscat Daily, accessed on 29 July 2023

57 AGSIW | Oman's Protesters Seek Jobs and Reform, accessed on 25 July 2023

that the sponsorship system facilitates the abuse of foreign workers and limits Omanis' opportunities and prevents them from competing based on qualifications. [58]

With regards to gender, the unemployment rate of women (age group 15+) was estimated at 12.90 % in 2018 while the unemployment rate of men (age group 15+) was estimated at 1.70%. This rate has decreased slightly compared to the 2016 values reported by ILO: 13.70% for women versus 1.80%[59]. According to a media articles dated July 2023, the rate of female jobseekers was high, at 13.7% compared to 1.7% for males. Bachelor's degree holders formed the largest group of jobseekers, accounting for 11.3%.[60]

6.8.2.2 Labour Welfare

Relevant Oman legislation relative to labour rights includes the following:

- Royal Decree No. 35/2003: Labour Law. It applies to all Omani or non-Omani private sector employees (other than domestic workers, Omani civil servants and security forces employees), employed by local or foreign companies having an office in Oman; and
- Ministerial Decision No. 286/2008 approving the Regulation on Occupational Safety and Health for Establishments
- Ministerial decision No. 11/2008, concerning the approval of the "Guide to Labour Inspection".

In summary, these laws establish measures to ensure the health and safety of workers in their workplace, defining the obligations of the employer and workers on these matters. These laws also regulate the equality of all workers before the law *"when the nature and conditions of their work are similar"*[61].

The Department of Labour Inspection organizes inspection visits to the private sector's establishments, to ensure their compliance with the laws and decrees through three sections: the Routine Inspection Section, the Work Permits Inspection Section and the Foreign Workers Recruitment Agencies Section.

Oman has also ratified four out of the eight fundamental ILO conventions. These include conventions No. 29 and 105 on the elimination of forced labour, conventions No. 138 and 182 on elimination of child labour. Oman has not ratified the conventions No. 100 and 111 on non-discrimination, and conventions No. 87 and 98 on freedom of association and the right to organize[62].

In 2010, Oman enacted its Decent Work Country Programme (DWCP), the ILO's main triennial instrument for supporting countries. The DWCP was extended in 2014 for another two years and focused on labour Omanisation, social dialogue, labour administration, International Labour Standards and social protection. Since then, it was decided between the Ministry of Labour and social partners that a DWCP program will run from February 2018 until February 2020.

The Royal Decree No. 35/2003, issuing the Labour Law covers general work parameters and regulations, including employment of citizens and foreign workers, employment contracts, wages, benefits and working hours, employment of juveniles and women, industrial safety, employment in mines and quarries, representative committees, disputes and penalties for employers or employees.

A Royal Decree issued on 8 July 2006 gives workers the right to form trade unions. There must be at least 25 employees for a union to be formed. Since then, few Trade Unions have been founded,

[58] AGSIW | Oman's Protesters Seek Jobs and Reform, accessed on 25 July 2023
[59] The Arab Development Portal. Oman Statistical Snapshot 2019
[60] Unemployment, a growing challenge in Oman (muscatdaily.com), accessed on 29 July 2023
[61] Article 11 of the Oman Labour Law. Sultanate of Oman, Ministry of ManPower- Labour Law. 2012. Consulted in October 2019.
[62] ILO Ratifications for Oman. Accessed in October 2019 at: https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:103441

including the national General Federation of Oman Trade Unions (GFOTU) in 2010. The ILO has provided technical services to the GFOTU for the setting of its First Congress in 2014.

The 2023 Desktop Research also indicated reports that domestic workers are victims of widespread abuse, including physical and sexual abuse[63]. According to several reports, female migrant domestic workers are at high risk of suffering human right abuses including exploitation by agencies and human trafficking under the visa-sponsorship employment system which grants recruitment agencies significant control over workers' residency and work visas and, therefore, their legal status in the country. The constraining system of the kafala (sponsorship) visa system is one of the main sources of abuse and exploitation of migrant workers[64].

Similarly, media articles reported cases of Indian construction workers having been repatriated following three months of unpaid wages, poor housing and low food supplies[65]. Some migrant women are allegedly kept in captivity by agents, trafficked and exploited[66].

6.8.2.3 Employment at the Governorate and Wilaya Level

The labour force participation in North Al Batinah is estimated of 298,961 in 2016. The Al-Batinah North governorate is considered to be the second governorate that employs the most workers, taking into account that more than two-fifths of the total employment in Oman (42.5%) in 2016 were working in Muscat governorate and 13.3% in North Al-Batinah governorate[67]. The percentage of males employed in the Governorate represents 84% of the total workforce while women represent 16%. Expatriate workers in turn represent 78% of the total workforce in the Governorate.

While the northern governorates concentrate a high percentage of the Omani population, they also have the highest unemployment rates, with urban areas having larger number of job seekers. Figure 6-10 shows the evolution of the unemployment rate in North Al Batinah from 2015 to 2018 versus the number of individuals that represent the labour force participation. According to the NCIS 2015 figures, 33.2% of job seekers were living in North and South Al Batinah. The figure also shows that the unemployment rate in the in the Governorate, according to the NCIS, was of 2.66% in 2016 and of 2.5% in 2018.

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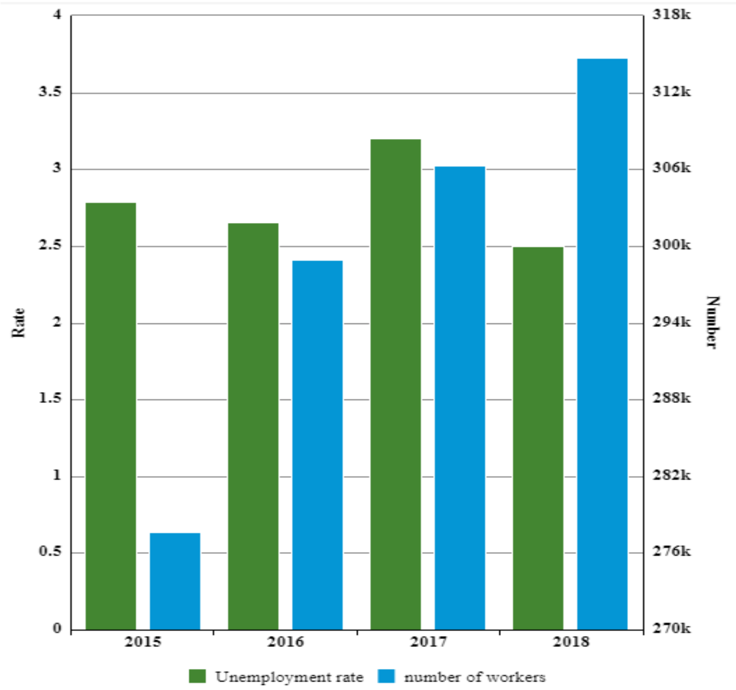
[63] Oman: Political magazine provides recommendations to authorities to protect domestic workers due to widespread abuse incl. sexual & physical abuse - Business & Human Rights Resource Centre (business-humanrights.org), accessed on 29 July 2023

[64] Oman: Political magazine provides recommendations to authorities to protect domestic workers due to widespread abuse incl. sexual & physical abuse - Business & Human Rights Resource Centre (business-humanrights.org), accessed on 19 July 2023

[65] Oman: 50 Indian construction workers repatriated following three month of unpaid wages, poor housing & low food supplies - Business & Human Rights Resource Centre (business-humanrights.org), accessed on 19 July 2023

[66] Oman: Indian domestic workers highlight human rights abuses, incl. exploitation by agencies and trafficking - Business & Human Rights Resource Centre (business-humanrights.org), accessed on 19 July 2023

[67] NCIS, 2017. Statistical Year Book



Source: NCIS, 2019

Figure 6-10 Unemployment Rate versus Number of Workers in North Al Batinah

As of 1 January 2023, 67.2% of the population in North Al Batinah were employed, 30% were inactive and 2.8% were job seekers. In Sohar Wilayat, there were 73.8% employees, 24.2% inactive people and 2% people seeking a job. In Liwa Wilayat, there were 69.7% employees, 28.2% inactive people and 2.1% people seeking a job. [68]

The Port of Sohar has been a key strategy from the government to reshape the governorates of Al Batinah to create more jobs for both the growing population in the Governorate and for Omanis relocating from elsewhere. In particular, the expansion of the Sohar Port South (50 ha added in the first phase and subsequent phases with added another 200 ha), has as objective to significantly boost the ability of Sohar to handle greater volumes of cargo traffic and simultaneously create new and sustainable jobs opportunities[69].

With respect to the industrial sector, discussions with community members, sheikhs, and port tenants (ie. Sohar Aluminium) have shown that the nature of employment opportunities available in the industrial sector in Sohar is mostly short-term and relate to the construction phase of projects. Moreover, it was reported that locals are not always prioritised during recruitment, with positions being filled by Omani nationals from other areas although the required skills may be available at the local level.

Based on discussions with sheikhs and community members (i.e. fishermen and farmers), locals from the area are most commonly employed as drivers or technicians (scaffolders, smelters, welders, electricians, plumbers, etc.). Companies demand for managerial or supervisory positions at the local level are limited. Indeed, while local community and governmental stakeholders claim that education levels and multiple specialisations for highly qualified positions (i.e. engineers, managers, etc.) are available at the local level, there seems to be a discrepancy between the skills and qualifications that industrial companies in the Port are looking for and the skills available in the local market. Specifically,

[68] Portalul eCensus, accessed on 29 July 2023

[69] Gulfnews, 2019. Sohar facilitates 15 years of continued economic growth in Oman.

challenges were highlighted in recruiting locals and Omani nationals in general for Human Resources, HSE, and financial positions.

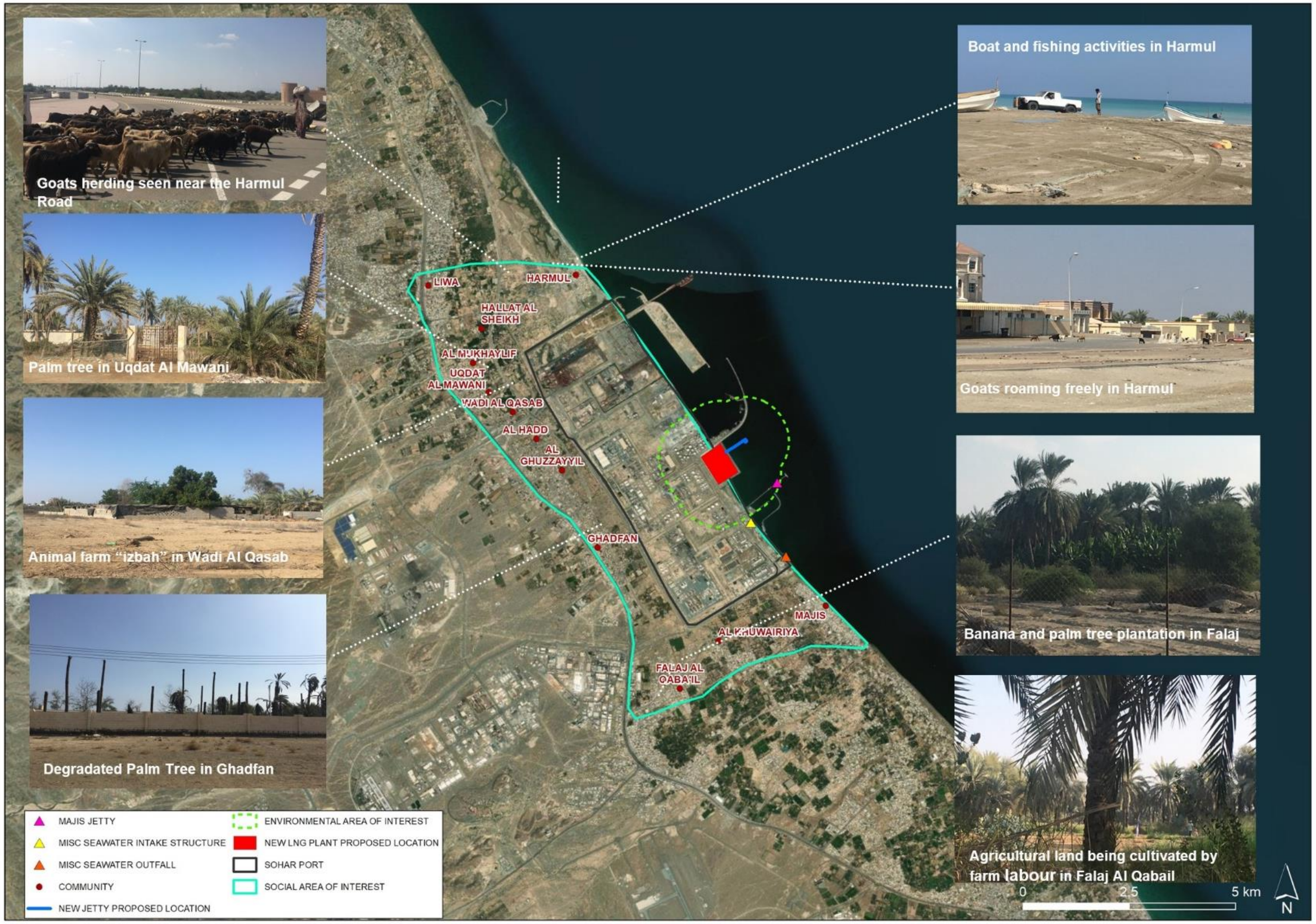
Generally, it was reported that little transitional training or support was made available to workers to help them transition into different jobs with the same company after the construction phase is over. Short-term construction employees who have dependents and financial obligations (i.e. families, rents, etc.) are more exposed and more vulnerable. Public sector jobs are generally preferred as they offer more stability and retirement benefits and are also perceived as more accessible.

Women are mostly active in the private sector as entrepreneurs or business owners, especially in the food processing sector. Women involvement in the textile industry has also recently boomed with the opening of the ‘Naseej’ industrial tailoring workshop in the area, providing employment for approximately 1,000 women. This initiative was started as a CSR project by Jusoor in partnership with the MoSD to train women on marketing and business skills and support them in establishing their own industrial tailoring business.

6.9 Livelihood Activities

The main livelihood and income generating activities in the area are fishing, agriculture, animal and livestock husbandry, small businesses and employment in the public and private sectors.

Figure 6-11 below provides an overview of livelihood activities observed in the area during the November field survey.



Source: ERM, 2019

Figure 6-11 Overview of Traditional Livelihoods in Settlements in the AoI

6.9.1 Fisheries

6.9.1.1 Overview

Fishing as the primary livelihood activity has been declining since the late 1980s and even more so since the establishment of the Port in the early 2000s. Today, MAF statistics for the Wilayat of Sohar and Liwa show that about 35% of registered fishermen are fulltime fishermen. The remaining 65% mainly found supplemental sources of income or alternative employment either with the Government or in the private sector. This being said, fishing is still considered an important economic activity in the area and constitutes the primary source of income for many fishermen for whom fishing generates 90% of household income, and a supplemental source of income for others, including those who are formally employed in the public or private sector. Overall, it is considered that the number of fishermen has not really decreased but that additional economic activities have been introduced as supplemental sources of income.

The general perception is that a combination of factors including loss of fishing grounds and access to sea, environmental pollution, and overfishing / illegal fishing practices have contributed to this decline. However, the establishment of the Port and industrial activities within the Port are viewed by stakeholders as the main causes of loss of fishing grounds and pollution.

6.9.1.2 Description of fishing activities in coastal settlements of Liwa and Sohar

All fishermen and fishing boats are registered with the Ministry of Agriculture and Fisheries (MAF). Traditional fishing is usually a family business where the boat owner is the family head and is supported by the members of the family in fishing and related activities. Fishing is both used as an income generating activity and for household consumption.

The Table 6-7 below presents the number of registered fishermen and boats in the Wilayat of Sohar and Liwa in 2018.[70]

Table 6-7 Number of Fishermen and Boats by Wilaya in 2018

Wilayat	No. Fishermen	No. Fiber Glass Boats
Liwa	837	280
Sohar	2,922	1,136
Total	3,759	1,416

Source: Ministry of Agriculture and Fisheries, 2019.

In the AoI, the main fishing communities are located in Harmul (Liwa) and Majis (Sohar). Al Hadd and Ghadfan settlements in Liwa host smaller fishing communities.

MAF statistics show that the number of registered fishermen and boats in the Wilayat of Sohar and Liwa have increased since 2014 as illustrated in Table 6-8 below. These numbers might be explained by the fact that the cost of living has been increasing and that more and more people are taking up fishing as a part time activity to supplement other sources of income, including formal employment. This interpretation is consistent with feedback collected during field survey discussions with fishermen, stating that the number of fishermen has not really decreased but that additional economic activities have been introduced as supplemental sources of income.

[70] Official data represents only Omani nationals fishermen

Table 6-8 Number of Fishermen and Boats by Wilaya (2014-2018)

	Fishermen					Boats				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Liwa	762	775	788	790	837	257	278	281	279	280
Sohar	2676	2764	2830	2877	2922	990	1024	1058	1100	1136
Total	3438	3539	3618	3667	37759	1247	1302	1339	1379	1416

Source: Ministry of Agriculture and Fisheries, 2019

6.9.1.3 Fishing techniques and gear

Traditional fishing techniques in the area commonly include boat seine fishing ('*Daghwa*'), cast nets ('*Hayal*'), gillnets ('*manasib*'), handlines, and traps. However the most commonly used technique is *Daghwa* or boat seine which are composed of teams of 15 to 20 members each.

The main artisanal fishing techniques are described in more detail below. During the field survey only traps and daghwa fishing were observed as these are the most common in the AoI.

- **'***Daghwa' or boat seine fishing* consists in a seine net (long net operated with two long ropes) being set to the sea from a boat. The nets are then hauled back to the boat and the boat is often pulled back into the shore using cars or small trucks. *Daghwa* is a type of surface fishing that generally occurs between 1 and 1.5 miles off the coast (up to 2km) and at a depth of 15 meters. *Daghwa* is considered one of the leading causes of over fishing of small pelagic species and also affects coral reefs and other marine life.
- **'***Hayal' or drift net fishing* consist in dropping the nets made of netting from local boats, either skiffs of dhows, to target fish swimming near the surface (upper 10 m). The nets are then recovered after several hours' soak time. Drift net fishing is usually practiced at night between 12 pm and 6 am.
- *'Manasib' or Gillnets* are made of strings of single, double or triple netting walls, vertical, near by the surface, in midwater on the bottom, in which fish will gill, entangle or enmesh. These nets can be used either alone or, as is more usual, in large numbers placed in line ('fleets' of nets). In small-scale fisheries gillnets can be hauled by hand from shallow or moderate depth.[71]
- *'Shubak Al Tasjeed' or lift net fishing* usually occurs near the coast and consists in bag shaped nets with the opening facing upwards which are submerged at a certain depth, left for a while using light or bait to attract fish over the opening, then lifted out of the water.[72]
- *Traps or cages* mostly made of netting wire are used to catch both demersal species and large pelagic fish (ie. Grouper '*hamoo*r', emperor fish, sea bream, tuna), as well as lobster.
- *Handline fishing* from boats.

Traditional fishermen mainly use handlines, gillnets and traps to catch demersal species in deeper waters further off the coast as well as medium to large pelagic species such as tuna and king fish. Boat seine, cast nets, and gillnets are used to catch small pelagic species closer to the coast.

Figure 6-12 below illustrates the practice of *daghwa* fishing and traps observed during the field survey.

[71] http://www.fao.org/fishery/geartype/107/en
[72] http://www.fao.org/fishery/geartype/105/en

Note: Daghwa fishing (left), Fishing boat and nets (centre) and fishing boat with fish traps (right) in Harmul

Source: ERM Field Survey, November 2019

Figure 6-12 Traditional Fishing Methods Observed in the AoI

6.9.1.4 Fish species and seasonality

The majority of fish landed by traditional fishermen in the Al Batinah region are large and small pelagic fish (accounting for approximately 80% of 2016 total landings) followed by demersal fish (accounting for 14% of 2016 total landings).

Based on discussions with fishermen in Majis and Harmul, small pelagic species are caught close to the coast in the nearshore. Medium to large pelagic species are also caught in the area and include grouper ('*hamoor*'), emperor fish, king fish, sea bream, and tuna (further offshore in international waters). These medium to large pelagic species are reportedly all high value fish sold for 3 to 5 OMR per Kg. However fishermen reported a decrease in the availability of these species throughout the years.

There is closed lobster season during the breeding and reproduction period from February to end of November (10 months).[73] There are also closed seasons for kingfish (from mid-August to mid-September) and shrimp.

6.9.1.5 Fishing grounds

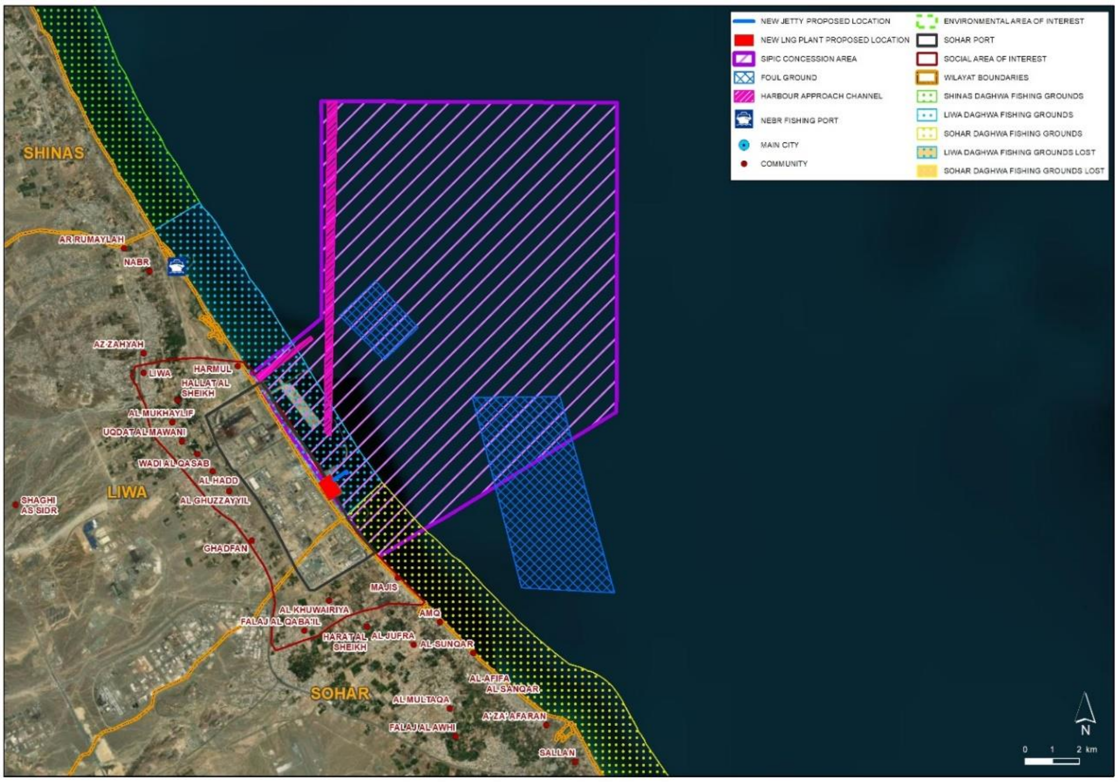
In offshore areas, the Batinah sea is attached to the governorates of Al Batinah North and Al Batinah South and enjoys open access. Fishermen also travel as far at the maritime boundary with Iran mainly to target tuna and other large pelagics such as Kingfish and Dorado. Fishing activities used to be focused primarily on nearshore fishing, however with increasing restrictions and loss of fishing grounds more fishermen are investing in boats that allow them to fish further offshore. Fishermen have formal ownership claims over traditional fishing grounds called *shudood* (or '*shad*' in singular) extending approximately 1 to 6 miles from the coast into the sea and consisting of purpose-built artificial reefs to aggregate fish and thereby improve the catch per unit of effort (CPUE).

Fishermen are not allowed to fish outside their fishing grounds unless agreed otherwise by the Sunat Al-Bahar. This was the case for fishing villages in Majis (Ghadfan and Al Hadd) that had lost access to their fishing ground due to the establishment of the port and were allowed to share shorelines with other villages such as Harmul for a time period.

The construction of the Port and the establishment of the marine concession and exclusion zone led to the loss of access to traditional fish landing sites and shoreline for beach seine and boat seine fishing for some communities such as Al Hadd and Al Ghadafan, as well as a significant decrease in the remaining available shoreline and fishing grounds for the same amount of fishing boats. In the nearshore area, individual fishermen who owned '*shudood*' were expropriated and compensated in nature (i.e. cash) for the loss of these areas. Most of the *shudood* located in the Port area have been compensated while fishermen who did not own any *shudood* were not compensated.

[73] http://www.fao.org/fi/oldsite/FCP/en/OMN/body.htm

Figure 6-13 shows the location of the fishing grounds for fishermen in Majis and Liwa and nearby Shinas, along with the fishing grounds that were lost in Sohar and Liwa due to the construction of the Port, and the Port exclusion zone.



Source: ERM, 2023

Figure 6-13 Restriction Zones and Fishing Grounds

6.9.1.6 Fish landing statistics

MAF statistics for fish landings show an increase in catches and values in the past two years (2017 and 2018) as illustrated in Table 6-9 and Table 6-10 below. Based on discussions with MAF, this increase can be partially attributed to i) government policy to support the sector stabilizing the value of landings due to fixed prices and government's efforts to provide soft loans to the sector; and to ii) increased fishing efforts in the area. However overfishing and illegal practices may also be a contributing factor.

Table 6-9 Fish Landing in Tons by Wilaya (2014-2018)

Wilaya / year	2014	2015	2016	2017	2018
Liwa	2,755	2,380	2,474	2,807	3,816
Sohar	7,338	7,978	8,111	8,817	12,567
Total	10,093	10,358	10,585	11,624	16,383

Source: Ministry of Agriculture and Fisheries, 2019

Table 6-10 Fish Landing Value (OMR1000) by Wilaya (2014-2018)

Wilaya / year	2014	2015	2016	2017	2018
Liwa	3,238	2,321	2,717	3,037	3,318
Sohar	8,771	7,152	8,214	8,984	10,158
Total	12,009	9,473	10,931	12,021	13,476

Source: Ministry of Agriculture and Fisheries, 2019

Children used to drop out of school before graduating high school (between age 14 and 17) to work as fishermen due to high earning prospects from fishing, but this has changed in the past 10 years due to lower fishing prospects. Young people prefer to look for formal employment whether in the public or private sector.

6.9.1.7 Environmental challenges and over fishing

The general perception is that a combination of factors including loss of fishing grounds and access to sea, environmental pollution, and overfishing / illegal fishing practices have contributed to the decline in fishing activities. However, the establishment of the Port and industrial activities within the Port are viewed by stakeholders as the main causes of loss of fishing grounds and pollution.

6.9.2 Agriculture

6.9.2.1 Overview

Agricultural activities in the AoI today are mostly limited to animal husbandry. However, some farmers from AoI settlements continue cultivating in areas that are less affected by groundwater salinity on rented agricultural land further away from the coast where alternative water sources are available.

For those farmers, agriculture has remained a primary source of income along with animal husbandry. This is the case of farmers from Al Khuwairiya who cultivate on rented agricultural land in Falaj al Qaba’il, a settlement located some 5 km south of Al Khuwairiya (still within the AoI) and in Falaj al Awhi approximately 10 km south (outside the AoI).

6.9.2.2 Farming

Today agricultural land is no longer given out in the area due to over-capacity and pressure on resources. The average size of an agricultural land plot is 10 to 20 feddan as farmers may also purchase additional parcels of land nearby to increase their plot sizes.

Farmers employ on average five workers for every 10 feddan to support with seeding, planting, cleaning, and maintenance tasks. Helpers in farms are mostly expatriate workers while farm owners and supervisors are Omani. Children below 16 are not generally involved in farming due to increased priority given on education over the past 10 years.

Farming activities in the area are usually small scale and serve both income generating commercial purposes as well as household consumption. Many farms in the Sohar area are not commercial and are kept active to keep traditions alive and produce food just for home consumption (such as dates). In the last three years, the government has considerably reduced financial support for agricultural activities. Small farm owners or non-viable farms are therefore left with a few options:

- Supplement their income with social assistance payments or ‘daman’ from the MoSD;
- Sell the land which often entails re-registering the land use for non-agricultural purposes; or
- Request a land use change from the MAF to develop the land for rental housing purposes.

Figure 6-14 below shows an example of a farm, which is being converted into a rental housing in Al Khuwairiya.

Source: ERM Field Survey, November 2019

Figure 6-14 Farm Converted to Residential Use in al Khuwairiya

Although farming is no longer a primary livelihood activity in the area, it is still an important economic activity for small-scale commercial farmers in the area. Specifically, in Al Khuwairiya and Falaj Al Qaba'il, it was reported that 90% of the produce is sold, of which approximately 30% is sold locally in the Sohar market and 70% exported to the UAE.

6.9.2.3 Types of crops and seasonality

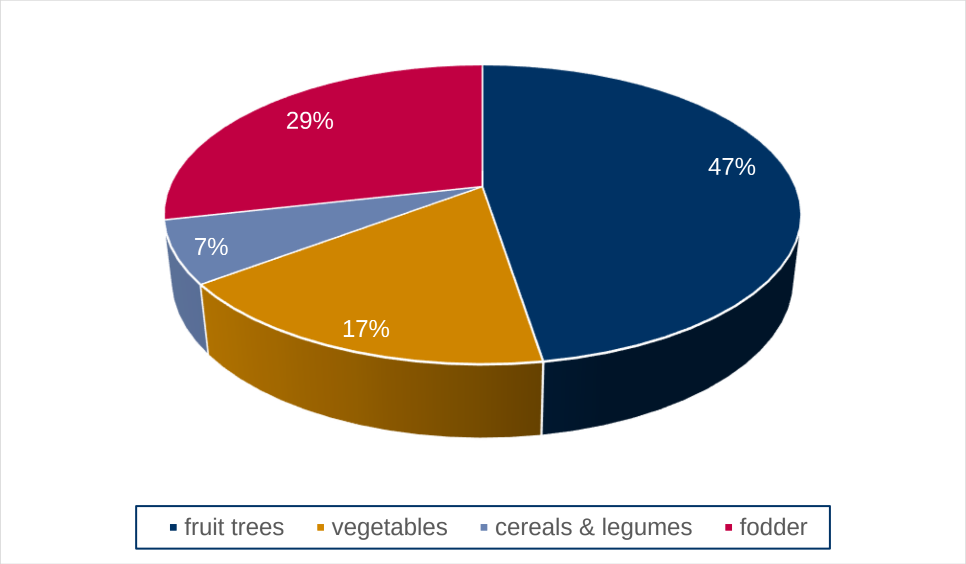
In the AoI where salinity levels of groundwater and soil are high, date palms (which can tolerate up to 12 ppt of salinity) and Rhode grass are the most viable crops although land is less productive and are cultivated all year long – see Figure 6-15 below.

As discussed previously, some farmers from AoI settlements rent and cultivate agricultural land further away from the Port in less affected areas. These farmers are able to cultivate both yearly and seasonal crops. Crops cultivated in the area include melon, predominantly in the winter months, mango and lemon in the summer months, and bananas all year round. Some vegetables are also produced in the winter months such as cucumber, eggplants, zucchini, okra, peas, onions, cabbage, cauliflower, tomatoes etc. Cereals and forage crops are also produced including maize, barley, cowpeas, and other types of grass for animal feed.

Source: ERM Field Survey, November 2019

Figure 6-15 Crop Fields in Majis Area

Greenhouses are not subject to seasonality and are able to grow fruits and vegetables all year round if adequate sources of water are available. As shown, in Figure 6-16 below, fruit trees represent 47% of all crops cultivated in the AoI, followed by fodder (29%). Note that, 75% of fruit trees are date palms.



Note: Specific data for Falaj Al Qaba'il and Hallat al Sheikh is not available as these two settlements are considered extensions of Al Khuwairiya and Liwa respectively. .

Source: Ministry of Agriculture and Fisheries, 2019

Figure 6-16 Crops cultivated in the AoI (2012-2013)

6.9.2.4 Water supply and irrigation

Water for irrigation and farming activities is mostly sourced from groundwater but also from traditional irrigation channels ('*aflaj*') where available, or through modern irrigation techniques (piped networks). *Aflaj'* are still in use in settlements such as Falaj al Qaba'il but to a lesser extent. In other settlements where '*aflaj*' are not available such as Al Khuwairiya, groundwater wells and improved irrigation networks are more common.

The groundwater balance is generally negative due to coastal location, lack of proper catchment areas and high pressure on groundwater demand and use. Salinity has also had a major impact on agricultural activities in the area strongly affecting land productivity.

Currently, the government is trying to deal with the problem by planning groundwater recharge dams in major 'wadis' (valleys) to stock water from elevated areas and supply coastal areas.

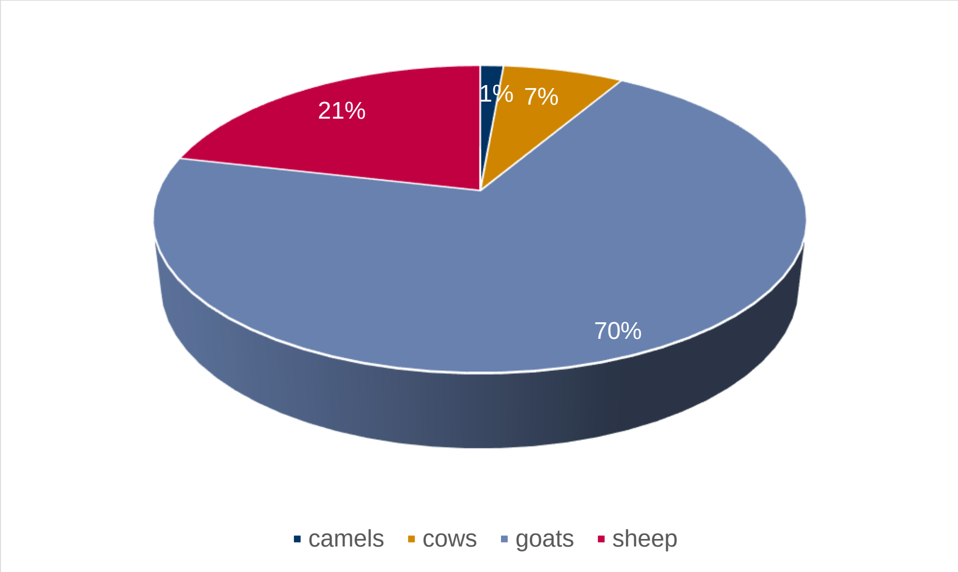
6.9.2.5 Changes to farming in the past 10 years

The main changes in farming in the past 10 years have to do with increasing water and soil salinity and the change in land uses due to an increasing development of the coastal area (from agriculture to other uses, such as the residential use). According to the Wali of Sohar, the issue of saline intrusion may have started even before the Port was established, although port activities and increasing use of groundwater by industries may have exacerbated the problem.

6.9.2.6 Animal husbandry

Agricultural activities in the area are in strong decline and mostly focused on animal husbandry. All farmers reportedly engage in animal husbandry as all farm owners also own cows, goats, sheep and camels, which are bred to produce milk and meat. Chicken are also bred for their eggs and their meat. Cow excrements are used as fertilizers.

As shown in Figure 6-17 below, 70% of animal husbandry activity in the area is camel breeding which is a male-dominated activity. Note that no data is currently available for chicken farming, which is reportedly an important activity in the area and is mostly led by women.



Note: Specific data for Falaj Al Qaba'il and Hallat al Sheikh is not available as these two settlements are considered extensions of Al Khuwairiya and Liwa respectively.

Source: Ministry of Agriculture and Fisheries, 2019

Figure 6-17 Animal Husbandry Activities in the AoI, (2012-2013)

Animal husbandry activities may be classified into two categories; commercial and non-commercial.

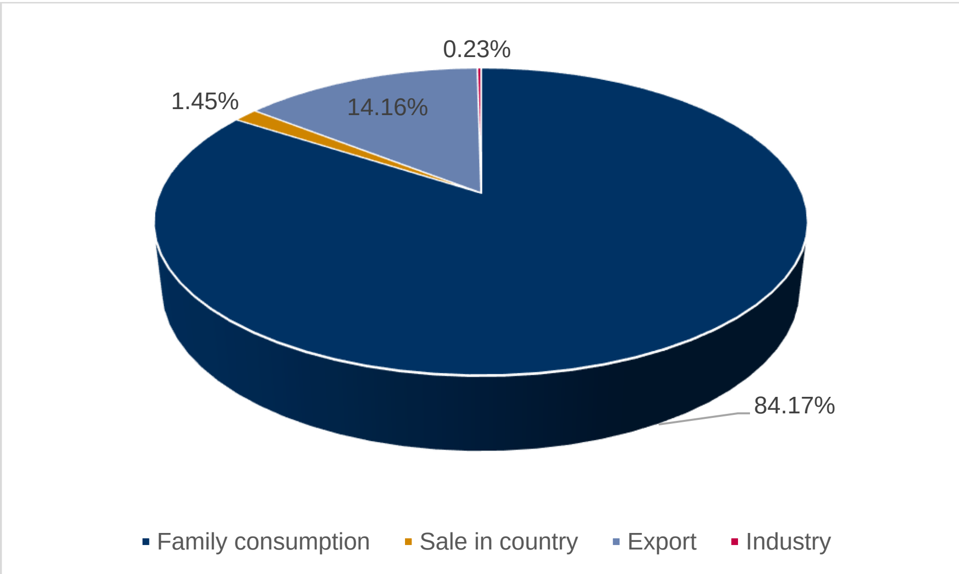
- Commercial farms in the area are mostly small (100-200 heads) – see Figure 6-18 below and produce is sold directly in the local markets. The Ministry of Regional Municipalities and Ground Water Resources, Food Safety Section, is responsible for giving out permits for commercial animal husbandry activities;
- Non-commercial animal husbandry is also widespread in agricultural farms and sometimes houses, although keeping animals in residential courtyards is not allowed for hygiene purposes. Animal grazing outside the farms is also not allowed except for camels, although animals are often observed grazing freely outside the farms. Non-commercial animal husbandry is primarily for household consumption but occasional sales can generate some supplemental income.

On the left: Goats herding activity seen crossing the road. On the right: animal farm 'izbah' in Liwa Al Jadidah

Source: ERM Field Survey, November 2019

Figure 6-18 Animal Husbandry in the Social AoI

As shown, in Figure 6-19 below, animal husbandry activities in the area are primarily conducted for non-commercial purposes (84%). As stated previously, no data is available for chicken farming.



Note: Specific data for Falaj Al Qaba'il and Hallat al Sheikh is not available as these two settlements are considered extensions of Al Khuwairiya and Liwa respectively.

Source: Ministry of Agriculture and Fisheries, 2019

Figure 6-19 Animal Husbandry Purposes in the AoI (2012-2013)

Women's involvement in agriculture today is reportedly marginal, but this trend is reverting as more income is needed for the households. Their role is mostly focused on animal breeding activities, food production and sale, and farm management or supervision. Some women own their farms.

6.9.2.7 Other agriculture-related activities

Agriculture-related activities include the rental and sale of farming equipment and agricultural inputs as well as food processing and sale. Activities include the following:

- Milk and yogurt ('*laban*') production
- Dates and mango paste production
- Vinegar production

- Honey production (although this activity is mainly male-dominated).
- Handicrafts using wool from sheep and palm trees to weave baskets, etc.
- Oils and perfumes production from henna and yass which are mostly grown in Liwa and Shinas (south of the AoI) and then dried and grinded.

6.9.2.8 Access to market and resources

Agricultural produce is either sold locally in the Sohar and Liwa markets or sold nationally or exported to the UAE through a middleman. In the case of Al Khuwairiya and Falaj al Qaba'il specifically, it was reported that 90% of the produce is sold, of which 30% is sold locally in the Sohar market and 70% is exported except for sweet melon which is only sold in the local or national market.

Higher farming costs combined with foreign imports, costly containers and tags and poor management of supply/demand for farmers during winter have made it increasingly challenging for small local farmers to sell their produce in local markets. These challenges are further exacerbated as the local government-run farming committee that helped farmers was dissolved in 2015. In contrast, animal husbandry, which has remained an important activity in the area, is reportedly well supported by MAF.

In terms of technical resources and assistance, the MRMWR in collaboration with the MAF have established a program to help farmers acquire desalinisation equipment. The MAF has provided technical programmes to women and men involved in agriculture.

6.9.3 Other livelihood activities

Secondary sources of income include trading and commerce (i.e. Retail, small shops, restaurants, SMEs for equipment rental, water distribution, etc.), transport (truck drivers and taxi drivers), and real estate (housing construction and rental). Traditional livelihoods no longer generate sufficient income. Figure 6-20 below shows examples of small businesses in the Majis.

Source: ERM Field Survey, November 2019

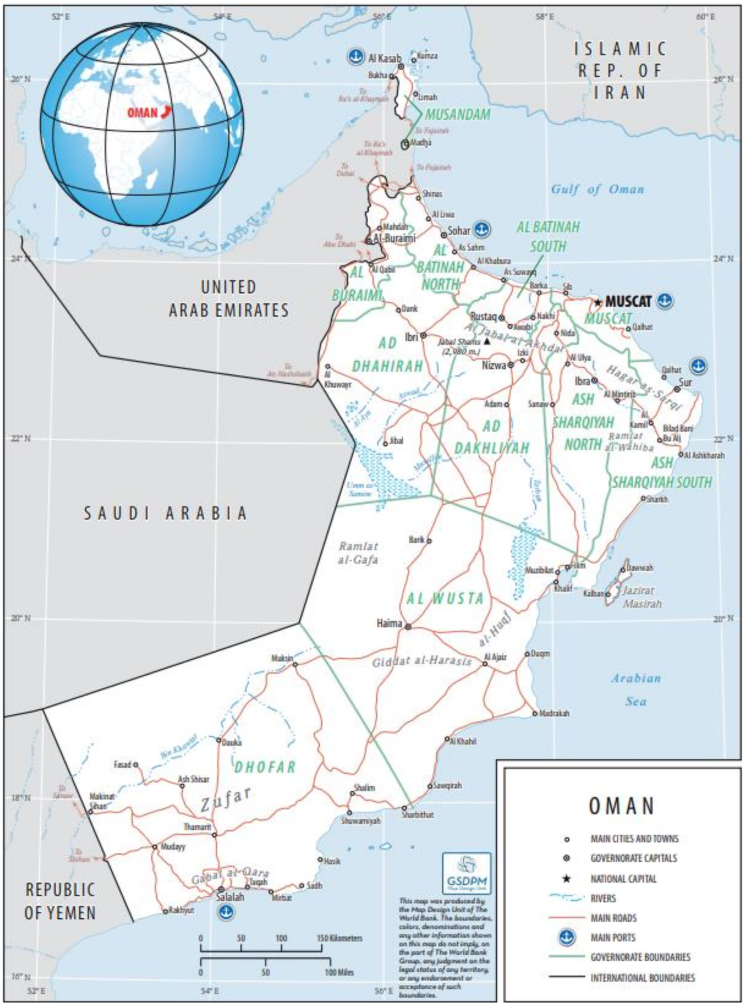
Figure 6-20 Small business in Majis settlement

6.10 Infrastructure and Public Services

6.10.1 Road and Transport Infrastructure

Oman has 64.000 km of roads connecting towns and villages, of which about 51% are currently paved. A project is under implementation to construct a national railway of 2,300 km, connecting the

UAE border with the Port of Sohar, Muscat, the new port of Duqm, and the Southern city of Salalah.[74] The following Figure 6-21 shows the transportation infrastructure available in Oman.



Source: Sultanate of Oman, ministry of transport & Communication (2015)

Figure 6-21 Transportation Infrastructure in Oman

The Port of Sohar is well connected to the inner parts of Oman (such as Al Buraimi) and to neighbouring export markets through a comprehensive road network. In addition to the extensive road network, the Port of Sohar is complemented by an international airport, founded in 2014[75].

According to the 2023 Desktop Research, Oman has signed agreements for implementation of several major developmental projects in Sohar Municipality at a total cost of more than 31$ million. These include road paving work in mountainous areas of Yanbu and Al Ard; rehabilitation of service roads in Falaj Al Qabail area, maintenance and rehabilitation of Nozha Road; rehabilitation of the service road in Turaif and Sohar Bridge in addition to design and construction of internal roads for industrial and commercial areas and rehabilitation of the parking of the commercial area in Al Hambar[76].

In North Al Batinah Governorate, a road project is under construction starting from Liwa roundabout on the Al Batinah Road and ending at the intersection of the Al Batinah Expressway with a length of

[74] World Bank, MOTC, Institutional and Governance structure of Oman's Transport Sector: Challenges and Options for Reforms. Also Oman-UAE Rail Project | Oman Rail, accessed on 29 July 2023

[75] https://www.omanairports.co.om/pdf/OAMC%20terms%20of%20services%202018.pdf

[76] Oman inks deal for key road development projects (tradearabia.com), accessed on 19 July 2023

5.5 km. The road will contribute to the recovery of commercial traffic in the state in addition to serving Sohar Port and the Free Zone[77].

6.10.2 Port of Sohar

6.10.2.1 Overview

The Sultanate of Oman has eight major ports. The Port of Sohar is a deep-draft port with remote-controlled container gantries capable of loading and unloading the world's largest container ships. Established in 2002, the Freezone, together with the port is managed by Sohar Industrial Port Company (SIPC), a 50-50 joint venture between the Port of Rotterdam and the Sultanate of Oman.

Source: ERM Field Survey, November 2019

Figure 6-22 Sohar Port seen from Harmul settlement

The port is built around four industrial clusters for metals, petrochemicals, logistics and food zone.

6.10.2.2 Emergency preparedness

SIPC has established an overarching Emergency Response Plan for the Port, including an oil spill response plan. Individual Port tenants are also required to have in place specific emergency response plans covering their operations. Currently, the main responder for emergencies in the Port area is PACDA and PESCo (for oil spill emergencies), while some tenants also have their own resources (firefighting trucks, ambulances, etc.).

SIPC is currently working on establishing a common platform for firefighting within the next two years.

6.10.3 Marine Traffic and Navigation

The Table 6-11 below provides statistics for vessel calls[78] in Sohar Port for the past five years. Based on these statistics, the number of vessels entering the port has increased by 70% in the past five years.

Table 6-11 Number of Vessel Calls in Sohar Port (2014-2018)

Year	2014	2015	2016	2017	2018
Total Number	2,021	2,545	2,626	3,075	3,444

Source: SIPC, 2019

[77] Work continues on Liwa dual carriageway - Arabian Daily News, accessed on 19 July 2023
[78] A vessel call is a stop for a vessel in a port to load/unload cargo or embark/disembark passengers.

There were 3,192 vessels calls in Sohar Port in 2022, increasing from 3,000 in 2020 but declining compared to 3,434 vessels call in 2018. The Port's exclusion zone for transit and fishing extends 3 km into the sea and 7 km wide. The SIPC Concession area is banned for fishing as well as for transit. In the case of complaints regarding destruction of fishing equipment or collisions outside the exclusion zone, SIPC refers the matter to the Ministry of Fisheries for an initial review and screening before addressing the issue.

6.10.4 Water Resources and Use

Oman is located in an arid region – consequently access to renewable natural water resources is limited. Groundwater is the main water resource utilised in Oman for domestic, industrial and agricultural purposes[79].

Approximately 92% of the total water abstracted from groundwater in Oman is for agriculture use[80]. Oman is now increasingly reliant on non-conventional water sources such as desalination and treated wastewater (TWW)[81].

In the project area, there are three categories of natural water resource: seawater, surface water and groundwater. Unconventional water sources in the project area also include seawater desalination and treated wastewater output.

6.10.4.1 Seawater

The Sohar desalination plan[82], strategically located in the Sohar Industrial Port, accounts for 92% of total domestic water demand in the governorate and is distributed through the municipal water network[83]. The seawater intake and outfall are part of the Sohar Industrial Port area common facilities and are owned by the Government of Oman and operated by Majis Industrial Supply Co (MISC). The potable water is exported and distributed to the local communities through a connection at the site boundary to the Oman Power and Water Procurement (OPWP) potable water network[84].

6.10.4.2 Groundwater

Al Batinah is the main agricultural region of Oman, accounting for 60% of the country's agricultural production[85]. A recent study[86] of the Groundwater Datasets in Sohar shows alarming rate of depletion of this aquifer on which so many farmers of the area rely. Figure 6-23 illustrates the average groundwater change of the catchment of Wadi Bani Umar, where lies the port of Sohar and vicinity[87].

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79 International Water Management Institute (IWMI), Groundwater use and policies in Oman, 2016.

80 http://www.omanws.org.om/en/page/about_oman

81 International Water Management Institute (IWMI), Groundwater use and policies in Oman, 2016.

82 HMR Consultants, Perkins + Will, (2013), Al Batinah Comprehensive Master Plan Report, (BCMP 2013).

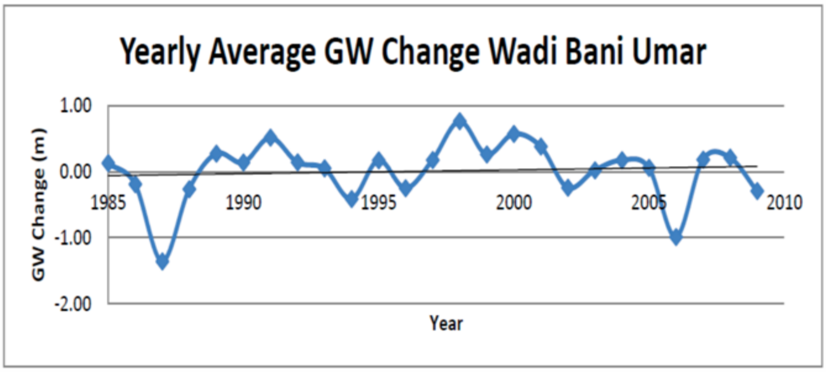
83 HMR Consultants, Perkins + Will, (2013), Al Batinah Comprehensive Master Plan Report, (BCMP 2013

84 Sohar Power and Desalination Plant. Available at: https://www.soharpower.com/history.php

85 http://www.fao.org/3/i1500e/Oman.pdf

86 Groundwater Datasets in Sohar, Oman, Osama Ragab, Sohar University, January 2016

87 Ragab, Osama. (2016). G.W Data sets in Sohar, Oman



Source: Ground.Water Data sets in Sohar (2016)

Figure 6-23 Yearly Average Groundwater Change Catchment of Wadi Bani Umar

The Figure 6-24 below shows an example of groundwater supplied in tankers in Ghadfan settlement.

Source: ERM field survey, November 2019

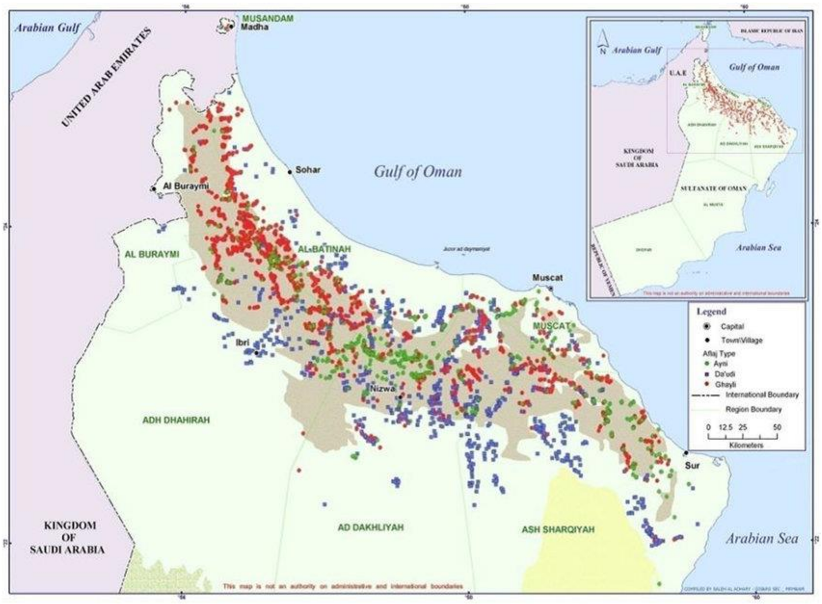
Figure 6-24 Groundwater Tankers in Ghadfan Settlement

According to the 2023 Desktop Research, a water supply project was inaugurated by Sohar Water Desalination Plant in Al Dahirah Governorate (outside the AoI) in January 2023. The project aims to ensure water security for Al Dhahirah Governorate, which depends mainly on groundwater, taking into account the current and future water needs and the rise in water demand for both the commercial and industrial needs[88].

6.10.4.3 Surface water

The already-mentioned Aflaj traditional water conveyance (see section 6.9.2) are a significant part of Oman's cultural heritage and indeed remains a commercially important piece of the country's water distribution system. The distribution of traditional irrigation systems in Norther Oman is presented in Figure 6-25.

88 Oman: $390mln project to supply water in Al Dhahirah Governorate opened (zawya.com), accessed on 25 July 2023



Source: MRMEWR,2001

Figure 6-25 Irrigation (*Aflaj*) Systems in Northen Oman

6.10.4.4 Treated wastewater.

Six Sewage Treatment Plants (STPs) are currently being operated in the North Al Batinah Governorate. Only a small portion of the treated wastewater from the Liwa treatment plant is used for industrial purposes (cleaning, firefighting, etc.).

6.10.5 Sanitation

In Oman, 97% of households are reported to have access to improved sanitation facilities (95% amongst rural households and 100% amongst urban households) and 93% of the population have access to drinking water from improved sources (85% of the water from desalination plants and 15% from wells).[89]

Sohar has about 100 km of sewerage pipeline network laid. Six STPS are currently being operated in the North Al Batinah governorate, including in Sohar and Liwa. Haya Water Company is updating the sewage master plan for nine governorates in the sultanate, including North Al Batinah.

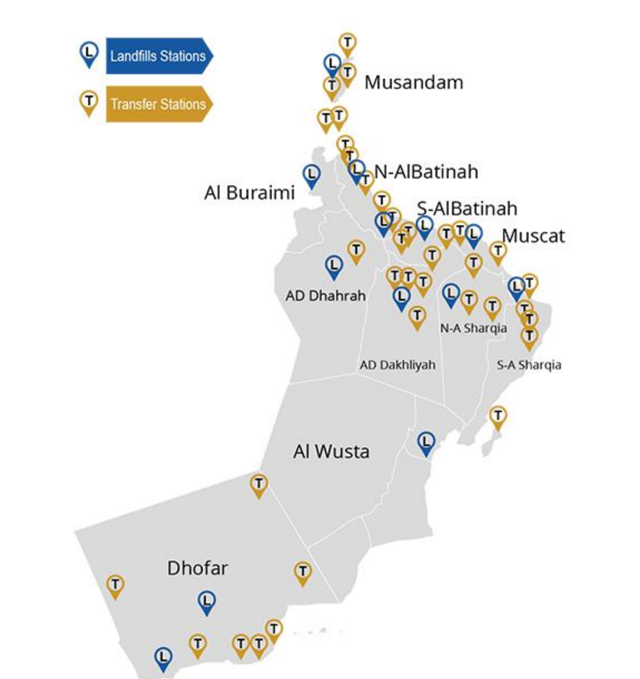
The current capacities of the STPs are not sufficient to cater for the flow generated in North Al Batinah Governorate and the excess flow is transported by tankers and discharged into open pits. The volume of the excess flow is not monitored to identify the deficit.

6.10.6 Waste

Since 2009, Oman Environmental Service Holding Company S.A.O.C (be'ah) is the entity responsible for solid waste management in the Sultanate of Oman as per Royal Decree No. 46/2009.

Illegal open dumping of waste remains a prevalent issue in the country. However, ever since its establishment, Beah closed 200 traditional dumpsites across the Sultanate.

[89] World Health Organization, Oman country highlights, 2015. Available at: https://www.who.int/water_sanitation_health/monitoring/investments/oman-7-dec.pdf?ua=1



Source: Waste Management in Oman: be'ah's strategy. beah, 2019

Figure 6-26 Waste Management Infrastructure in Oman

The existing storage strategy in North Al Batinah is based on allocating street lay-bys where waste is temporarily stored in specific containers before being transported to a Transfer Station (TS), operated under Be'ah's Authority. Municipal Solid Waste (MSW) is collected comingled in one lot, with no source separation being applied. Figure 6-27 below illustrates the waste collection process in settlements observed during the November field survey.

Source: ERM field survey, November 2019

Figure 6-27 Waste Collection by be'ah in Harmul Settlement

To overcome the problem of hazardous waste including Industrial Waste, an Integrated Industrial Waste Management facility (of around 240 Ha) is planned in Sohar Freezone. This project has completed as of 2019 and will be operated by SUEZ who have been awarded by Beah. This takes into consideration that 90% of all hazardous waste generated in the Sultanate is generated in Sohar.

6.10.7 Energy

Oman depends entirely on oil (33 %) and gas (67 %) for its energy requirements. The existing power generation[90] plant in North Al Batinah include the following power plants:

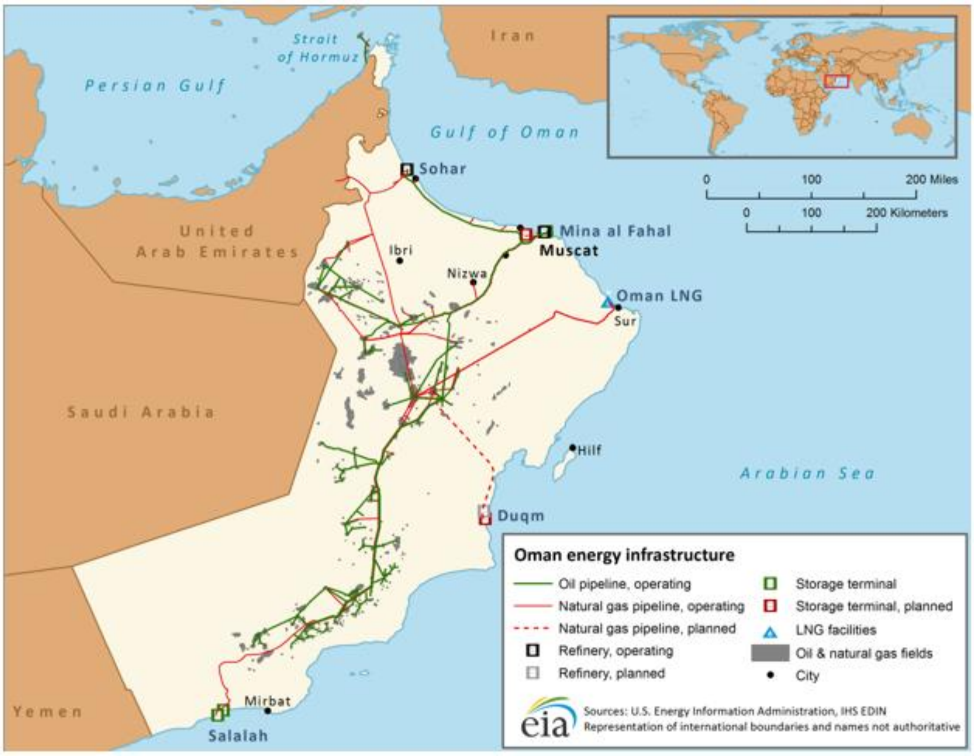
- Wadi Jizzi Power Station (not operational since 2018)
- Sohar I Power and Desalination Plant
- Sohar II Power Plant
- Sohar Aluminium
- Shinas Power Generatig Company

North Al Batinah has five grid stations rated at 220kV and eight stations at a voltage rating of 132kV.

6.10.8 Oil and Gas Infrastructure

As shown in Figure 6-28 below, Sohar has both operating refinery, operating oil pipelines and operating natural gas pipelines[91].

[90] OETC 5-Year Annual Transmission Capability Statement (2017-2021)
[91] https://www.eia.gov/beta/international/analysis_includes/countries_long/Oman/background.htm



Source: U.S Energy Information Administration, HIS Markit Midstream Database

Figure 6-28 Oman's Major Oil and Gas Infrastructure

6.10.9 Housing

Various types of housing are present in Oman: Villas; Arabic houses[92]; Apartments; Rural houses, Rooms, and Improvised shacks.

As shown in Figure 6-29 below, as of 2016, the Arabic house is the most prevalent housing type in the Sultanate of Oman (39%) followed by the villa (31%).

It should be noted however that this data does not take into account that today most of the population in the settlements from Ghadfan up to Hallat al Sheikh to the North have been resettled and the majority of remaining houses in these settlements are being demolished. Also, recent field observations during the November 2019 field survey have shown that villas are among the most common type of housing.

According to the 2023 Desktop Research, a new residential community project in Liwa was completed in 2022[93]. It is a residential community project with 3,500 homes built for those affected by the activities of the Sohar Port. The scope of work includes the development of 2,963 residential plots on 12,5 million m^2 and the implementation of infrastructure, roads and lighting projects[94].

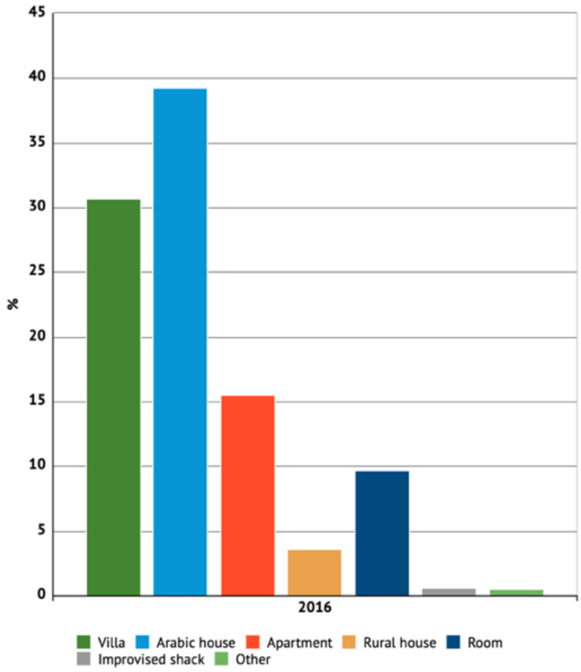
2019 field observations and discussions have also shown that rental housing has significantly increased in the past 10 years to satisfy the population increase and the demand for rental housing by expatriate workers and Omani workers from other areas. Home ownership is low according to the Household Income and Expenditure Survey conducted by the National Centre for Statistics and Information in 2019, indicating that 1.2% of Omani households owned a house, compared to 87.6 per cent in the 2011 survey. The percentage of Omani households living in villas increased to 56.8% in

[92] The traditional Arabic house. 1988. Basam Behsh. Available at: http://arkitekturforskning.net/na/article/download/1075/1015

[93] https://www.omanobserver.om/article/1128975/oman/liwa-residential-city-to-open-today accessed 25 July 2023

[94] New 3,500 home residential community project announced for Liwa in Oman (meconstructionnews.com), accessed on 25 July 2023

2019, compared to 36.9% in the survey of 2011. The percentage of expatriate households living in rented houses increased to 68.5%, compared to 49.4% in 2011.[95]



Source: NCSI, 2016

Figure 6-29 Type of Housing Facilities (Oman)

Examples of housing facilities observed in the AoI during the field survey in 2016 are illustrated in Figure 6-30 below.

95 Average household income in Oman jumps by more than 21% (zawya.com), accessed on 29 July 2023

Arabic House in Liwa al Jadidah (left); apartment building for rent in Falaj Al Qaba'il (right); and villa in Harmul (bottom)

Figure 6-30 Examples of Housing Types in the AoI

6.11 Education and Skills

6.11.1 Literacy Levels

Based on the last UNESCO Country Report data, the percentage of literate population in the country increased from 86.9% in 2010 to 95.6% in 2018 as a result of the national policies for the promotion of education[96]. Despite these positive results, the percentage of illiterate women (7.3%) remains significantly higher than for men (3 %) at national level.

Similarly in the Al Batinah Region, the percentage of illiterate population decreased from 18.6% in 2003 to 13.7% in 2010. Literacy rates at the Governorate and Wilayat levels were not made available at the time of writing.

6.11.2 Education system and attainment

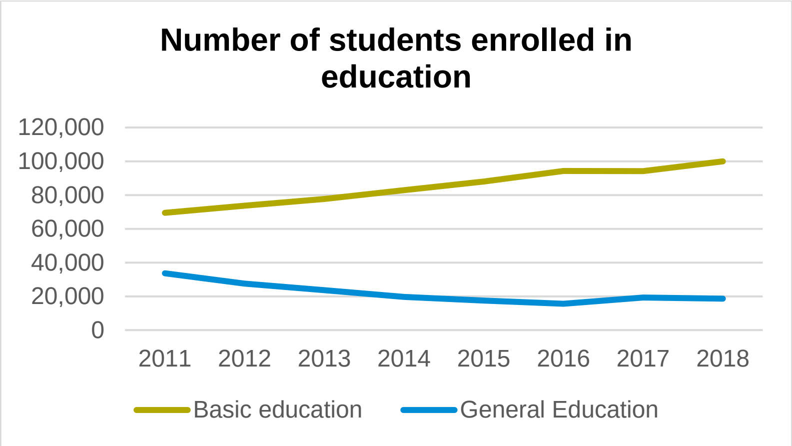
The Oman education system is divided into the following levels:

- Pre-school
- Basic Education: including Grades 1-4 (Cycle 1) and Grades 5-10 (Cycle 2)
- Secondary Education: including Grades 11-12
- Tertiary Education

[96] UNESCO Oman Country Report accessed in October 2019 at: http://uis.unesco.org/en/country/om

Education is not compulsory at any level. The Sultanate provides the basic education free of charge. Oman's education system is composed of both public and private education. In Sohar, schools for students with special needs are public. Higher education can be public or private and it is overseen by the Ministry of Higher Education.

The national average of school life expectancy was 12.82 years in 2016.[97] School enrolment of children in primary education progressed in the last decades with 92.5% of school enrolment in 2018[98]. In 2018, the governorate of North Al Batinah registers 99.9% of school enrolment of children in basic education (see Figure 6-31).



Source: NCSI

Figure 6-31 Education Attainment in North Al Batinah

Specific data on education attainment levels at the Wilaya level is not available, however some observations can be made on the education levels of fishing communities based on a study on the Fisheries Community of Al Batinah region conducted in 2012.[99] According to this study, in Sohar and Liwa, 30.4% of fishermen in Sohar hold high school diplomas, while some stopped at primary studies. In Liwa, the majority of fishermen (27%) graduated primary school, while 1.8% held high school diplomas. This may explain why fishermen and youth from fishing communities find it more difficult to benefit from job opportunities in the area, especially with the private sector.

6.11.3 Education infrastructures

6.11.3.1 Higher education institutions

Higher education institutions are present in the area and offer relevant programs in engineering, applied sciences, information technology, and business; however, information on the curriculum offered, attendance rate and demographic profile of graduates was not available. Similarly, data for education attainment at the Wilaya level and for the different specializations was not available to include in this report.

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97 Trading Economics based on World Bank indicators accessed in October 2019 at: https://tradingeconomics.com/oman/school-life-expectancy-primary-and-secondary-both-sexes-years-wb-data.html

98 The World Bank Open Data. Oman accessed in October 2019 at: https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=OMN

99 The Fisheries Community of Al Batinah Region in Oman: A Socioeconomic Overview. Journal of Fisheries Science, August 2012. Accessed at: https://www.researchgate.net/profile/Manaa_Alhabsi/publication/232031534_The_fisheries_community_of_Albatinah_region_in_Oman_A_socio-economic_overview/links/0fcfd5072a28becb6e000000/The-fisheries-community-of-Albatinah-region-in-Oman-A-socio-economic-overview.pdf

Table 6-12 below summarises the higher education institutions located in Sohar area.

Table 6-12 Higher Education Institutions in Sohar area

Institution	Location	Affiliation
Institute of Sharia Sciences	Al Khuwairiya	Ministry of Awqaf and Religious Affairs
College of Applied Sciences	Sohar	Ministry of Education
Shinas College of Technology	Shinas	Ministry of Labour
North Al Batinah Nursing Institute	Sohar	Ministry of Health
Sohar University	Sohar	Private Higher Education
Sohar Maritime College	Majis	Private Higher Education

Source: Oman Higher Education Administration Centre, 2019[100]

6.11.3.2 Public and private schools

More than half of the schools in the North Al Batinah (70%) are within Wilayat Sohar. The number of teachers per pupil remains low for both wilayats of Sohar and Liwa.

Public schools are mainly used by Omanis and sometimes by expatriates from Arab speaking countries. Expatriates mainly use private schools.

Governmental vocational training centres overseen by the Ministry of Labour are also present in the AoI, as well as private vocational training centres such as the National Training Institute (NTI). The NTI has a branch in Sohar. Examples of the education and leisure facilities observed in the AoI are presented in Figure 6-32 below.

Sports centre (left) and its football field (right) in Majis

[100] http://www.heac.gov.om/index.php/en/institutions


Secondary school for girls in Hallat al Sheikh (left) and children playground donated by Orpic in Majis (right)


Secondary school for girls (left) and Liwa hall cultural centre (center) and football field (left) all in Wadi Al Qasab

Source: ERM Field Survey, November 2019

Figure 6-32 Education and Leisure Facilities in the AoI

6.12 Health

6.12.1 Health Overview

In Oman, the health service is divided into three levels: primary, secondary, and tertiary. The primary level is represented by regional health centres and local hospitals, the secondary level comprises regional and district hospitals, and the tertiary level refers to the eight[101] national hospitals. Oman has prioritized financial access to primary health care. The Health Ministry offers free universal health care to all Omani nationals and expatriates working in the government sector, including access to mental health services and associated medicines. The expatriate workforce in the private sector is mostly covered by employer-provided insurance.[102]

The health overview considers the leading causes of death and three key health indicators (maternal death rate, under-five death rate, and life expectancy) as a measure of over-all population health. The majority of the top ten causes of death and disability are due to non-communicable (i.e., chronic) diseases.

In 2021, the infant mortality rate and the under-five child mortality rate increased to 8.1, respectively 10.1 deaths per 1,000 live births. Life expectancy at birth also decreased from 75.7 years in 2020 to

[101] Hospitals - Ministry of Health (moh.gov.om), accessed on 29 July 2023
[102] Oman: Access | PHCPI (improvingphc.org), accessed on 29 July 2023

74.1 years in 2021[103] and as noted in the 2021 Annual Health Report released by the National Centre for Statistics and Information in 2022, it was attributed to be an effect of the COVID-19 pandemic.

According to a 2021 Annual Health Report[104], the governorate of North Al Batinah registered the highest number of out-patient visits by the Ministry of Health, recording 19% of total out-patient visits nationally. North Al Batinah also registered the highest percentage (22%) of all patients with ear illnesses, at primary health centres across the country. North Al Batinah follows Muscat with the second highest number of new patients to mental health clinics, at 3,678.

6.12.2 Communicable Diseases

Data comparing mortality rates for disease groups was obtained for Al-Batinah North and Oman from the 2020 Statistical Year Book (National Centre for Statistics and Information [NCSI], Sultanate of Oman, 2020). Table 6-13 indicates that mortality rates for infectious diseases, respiratory system, circulatory system, digestive system and genitourinary system are higher in Al-Batinah North than in Oman as a whole. Compared to the 2016 data, diseases of the respiratory system have dropped both at country and governorate level while rates of infectious and parasitic diseases have not changed.

Table 6-13 Selected Disease Mortality Rates in Hospitals (2020 data)

Diseases	Oman	Al-Batinah North
	Percentage	
Infectious and parasitic diseases	14.8%	22.3%
Neoplasms	9%	6.8%
Diseases of the Respiratory System	4.1%	7.9%
Diseases of the Circulatory System	7.1%	8.5%
Disease of the Digestive System	1.4%	1.5%
Disease of the Genitourinary System	1.7%	1.8%

Source: Ministry of Health 2020. Table 9- 32: MOH Hospital Death Rate (% of discharges of respective disease Category for 2020 according to Disease Categories & Health Governorates)[105].

Among communicable diseases, although airborne infections are the main cause for inpatient morbidity (9.3%), the number of episodes dropped from 83 (11.6%) per 10,000 population in 2019 to 45 (9.3%) in 2020. The overall communicable diseases decreased from 111 (15.5%) per 10,000 population in 2019 to 58 (11.8%) in 2020. [106]

6.12.2.1 Sexually Transmitted Infections

In 2017, the prevalence rate of HIV in Oman was 6 per 100,000 Omani (NCSI 2017). Table 6-14 shows the large increases in incidence rates for STIs in Oman between 2000 and 2012.

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[103] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنويba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[104] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنويba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[105] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

[106] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

Table 6-14 Incidence of Sexually Transmitted Infections in Oman (per 100,000 population)

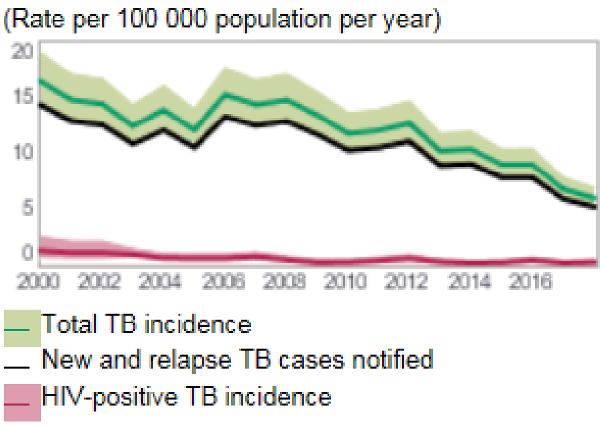
Disease	2000	2005	2010	2012
Sexually Transmitted Infections (100,000 Omanis)	40.1	51.8	88.5	126.6
Syphilis (100,000 Omanis)	5.7	2.2	1.8	0.9
Gonorrhea (100,000 Omanis)	13.7	3.4	3.9	3.2
AIDS (100,000 Omanis)	4.67	5.7	7.4	6.1
Ratio of Deaths to HIV Cases Registered	30.0%	22.9%	26.6%	26.0%

Source: Ministry of Health, 2014

In 2021, there were 202 cases of HIV among Omani nationals registered in the Ministry of Health, indicating an increase of 37.4% from 147 cases in 2020 but decreasing when compared to 2019 (174 cases, an all-time high since 2015); 84% of the cases recorded referred to males compared to 80% in 2020. The number of new HIV infections per 1,000 uninfected population in 2021 was 0.02 for women (constant compared to 2020 but dropping from 0.03 in 2016 to 2019) and 0.07 for men (increasing from 0.05 in 2020, and 0.06 for men in 2017-2019).[107]

6.12.2.2 Tuberculosis

According to the Regional Office of the Ministry of Health, a case of tuberculosis was reported in one of the labour camps in Sohar in the past year, but it was successfully contained.



Source: WHO 2019
https://extranet.who.int/sree/Reports?op=Replet&name=/WHO_HQ_Reports/G2/PROD/EXT/TBCountryProfile&ISO2=OM&outtype=html

Figure 6-33 Tuberculosis Incidence in Oman 2000-2016

In 2021, the incidence of tuberculosis was 5.1 per 100,000 population, declining from 6.8 in 2020, 7.8 in 2016 and 7.97 in 2019. A total of 89 Omanis and 144 Non-Omanis were registered with the disease in Oman in 2021, of those, 6 Omanis and 17 Non-Omanis resided in North Al Batinah, according to the 2021 Annual Health Report released by the National Centre for Statistics and Information in 2022.[108]

[107] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنوي+ba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[108] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنوي+ba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

6.12.2.3 Middle East Respiratory Syndrome Coronavirus

MERS-CoV is a virally-caused severe respiratory illness first identified in 2012. Since 2013, 24 cases of the disease and 7 deaths have been reported in Oman. In January and February of 2019, 12 cases of MERS-CoV were reported for Oman, and 9 of those cases were from Al-Batinah North. According to the 2021 Annual Health Report released by the National Centre for Statistics and Information in 2022, no cases were reported in 2021.

6.12.2.4 COVID 19

In Oman, from 3 January 2020 to 26 July 2023, there have been 399,449 confirmed cases of COVID-19 with 4,628 deaths, reported to the WHO. As of 25 October 2022, a total of 7,086,050 vaccine doses have been administered.[109]

6.12.3 Chronic Diseases

Close to 28% of the surveyed households in the AoI (Social Baseline study, LIPC, ORPIC, 2016) has at least one family member with a serious chronic illness or life-threatening disease. Among such households, diabetes coupled with high blood pressure (37.5%), asthma (45%) and cancer (12%) where named as the top three diseases prevalent in these households in the last three years.

Specific chronic illnesses are discussed further in the following sections.

6.12.3.1 Cardiovascular Diseases

Cardiovascular diseases are the leading cause of death in Oman (32.5 percent of hospital deaths in 2012).

6.12.3.2 Diabetes

Diabetes was the fourth cause of death in Oman in 2017. Prevalence of diabetes was 15.7% in 2021, rising from 12.30% in 2020.[110]

6.12.3.3 Cancer

Cancer rates in Oman are approximately half the rate globally, likely due to the young average age of the Omani population (Al-Lawaati et al 2019). North Al-Batinah had cancer death rates lower to the national percentage in 2020 – see Table 6-14 above.

6.12.3.4 Chronic Respiratory Diseases

Sohar industrial zone (SIZ), Oman, which started operating in 2006, contains many industries that potentially affect the health of the local population.

6.12.3.5 Non-communicable diseases

The non-communicable diseases, at national level, have decreased from 50.6% in 2020 to 48.5% in 2021. Diseases of respiratory system have increased to 14 (2.6%) per 10,000 population in 2021 from 9 (1.9%) in 2020 but have slightly declined compared to 18 (2.5%) in 2019. The same trend is seen between 2021 and 2020 for neoplasm, diseases of the nervous system, circulatory system, digestive system, diseases of skin and subcutaneous tissue and congenital anomalies.[111]

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[109] Oman: WHO Coronavirus Disease (COVID-19) Dashboard With Vaccination Data | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data, accessed on 29 July 2023

[110] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنوي/ba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[111] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنوي/ba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

6.12.4 Accidents and Injuries

Physical harm can be caused by either unintentional or intentional injury. Unintentional injuries, or death, typically results from accidents that occur during transport, in the workplace or home, or during leisure time activities. Intentional injuries result from interpersonal violence (assault) and self-harm.

In Oman, road traffic-related accidents were the leading cause of death in 2017 and traffic-related injuries are the leading contributor to burden of illness (disability) in the country. According to the 2021 Annual Health Report released by the National Centre for Statistics and Information in 2022, the death rate due to road traffic injuries was 9.6 per 100,000 population, decreasing from 15.7 in 2016 and 11.0 in 2019 but increasing compared to 8.1 in 2020.[112]

Speed was the biggest cause of accidents, while other causes of accidents include misconduct while driving, negligence, failure to leave appropriate safe distance between vehicles, overtaking and vehicle defects. [113]

The 2023 Desktop Research also indicated that 42 people suffered moderate to serious poisoning following a gas leak in Muwailah Industrial area in Sohar, North Batinah Governorate. Sohar Hospital and the public and private health centres received 42 people suffering from poisoning[114].

6.12.5 Healthcare Infrastructure, Accessibility and Quality

At the AoI level, there is one public health centre in Falaj Al Qaba'il, which provides primary care services (level 1) to all three settlements of Majis, Al Khuwairiya, and Falaj al Qaba'il. There is also one health centre in Liwa and a public clinic. These centres are reportedly under increasing pressure due to the growing population in the area. For cases requiring more specialised care, patients are transferred to Sohar hospital or to Muscat respectively. The Sohar hospital is located approximately 20 km away from the AoI settlements located in Sohar.

The two private hospitals in the area of Sohar (Lifeline hospital and Badar al Sama polyclinic) and the Aster Medical Centre in Liwa are too costly for locals and mostly used by expatriates, although locals may go to private hospitals or clinics in emergency cases to receive direct attention and faster access to a specialist.

Figure 6-34 below shows the location of the main health facilities in the AoI or in close proximity to the AoI,

6.12.6 Determinants of Health

6.12.6.1 Social Determinants of Health

Social and behavioural health risk factors relevant to this project include poverty, hygiene, community sense of safety, and substance abuse. These factors are used in the impacts section to assess the vulnerability of a population to changes related to the influx of construction workers and operation of a new industrial facility in the area.

The national-level mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene was 0.01 per 100,000 population in 2020 and 2021, declining from 0.02 in 2019 and 0.04 in 2017. [115]

Approximately 6.3% Omani and 14.2% smoked as of 2021; by sex, 15.8% of men and 0.5% of women in Oman leading to an average 8.5% of the population smoking. Approximately 26.6% of male

[112] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنويba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[113] Road accidents in Oman down 60% - Muscat Daily, accessed on 29 July 2023

[114] 42 suffer poisoning after gas leak in Sohar (muscatdaily.com), accessed on 19 July 2023

[115] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحي+السنويba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

teenagers and 3.6% of women teenagers smoked as of 2021. This highest percentage of teenager women smokers was recorded in North Al Batinah (52.6%) in 2021. Approximately 6.6% of male teenagers and 2.2% of women teenagers consumed alcohol as of 2021.[116]

Prevalence of obesity was 19.1% in total at national level in 2021 but it affected women more than men (15.6% male and 22.3% women).[117]

Contraceptive prevalence was 28% among urban women and 16% among rural women in 2021.[118]

6.12.6.2 Environmental Determinants of Health

The national-level mortality rate attributed to household and ambient air pollution increased significantly over the since 2016 and was 17 per 100,000 population in 2021 compared to 14.1 in 2020, 11.9 in 2019, 10.9 in 2018 and 6.9 in 2016. [119]

The Sohar Industrial Zone (SIZ) started to operate in 2006 and includes many industries that potentially affect local air quality and the health status of its surrounding residents. A 2015 study on health impacts from living near the Sohar Industrial Zone showed that living within the high and intermediate exposure zones (10 km from the Sohar Industrial Zone) was associated with a greater risk ratio for acute respiratory diseases, asthma, conjunctivitis and dermatitis compared to the control exposure zone. Greater exposure effects were observed amongst ages ⩾50 years and lower socio-economic status groups.[120]Another study was carried out to investigate the relationship between adverse health effects in the young population living in proximity to the Sohar industrial park suggested an increase of more than twofold to threefold in the risk of respiratory and allergic diseases among a young population living within 10 km of the industrial park[121]. As a preventive measure, the Omani government has resettled the population in proximity of the SIZ industrial park to a different residential area.

Although air quality monitoring data collected by the Environmental and Health offices reportedly show that indicators are within acceptable limits, community perception (according to the information collected during the baseline consultations) is that air quality degradation attributed to industrial activities in the Port has contributed to increasing incidences of asthma and respiratory illnesses and allergies.

Main health infrastructure in the AoI includes public health centres in Falaj Al Qabail and Hallat al Sheikh as well as 3 private clinics – see Figure 6-34 below. Additional private clinics and the Sohar hospital are located further away.

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[116] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحى+السنوىba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[117] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحى+السنوىba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[118] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحى+السنوىba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[119] 2021 Annual Health Report published by the National Centre for Statistics and Information, available at https://www.moh.gov.om/documents/274609/274947/99-2021/52125317+التقرير+الصحى+السنوىba-ef59-5e94-3d160840f02d, accessed on 9 August 2023

[120] Al-Wahaibi, A., Zeka, A. Health impacts from living near a major industrial park in Oman. BMC Public Health 15, 524 (2015). https://doi.org/10.1186/s12889-015-1866-3, Health impacts from living near a major industrial park in Oman | BMC Public Health | Full Text (biomedcentral.com), accessed on 29 July 2023

[121] Al-Wahaibi, A., Zeka, A., Respiratory and allergic health effects in a young population in proximity of a major industrial park in Oman | Journal of Epidemiology & Community Health (bmj.com), accessed on 29 July 2023

Figure 6-34 Location of Main Health Facilities in the AoI

6.13 Cultural Heritage

The Sultanate of Oman has always been a junction of the trade routes linking the Far East, Eastern Africa and Europe. As an old seafaring nation, Oman has taken part in the cultural and economic exchange among many nations. Because of its position on one of the oldest trade routes, the legendary silk road, the country possesses a rich archaeological and architectural heritage.

6.13.1 Regulatory Framework & International Standards

The Sultanate of Oman has enacted a modern and detailed statute protecting its cultural heritage. It provides broad protection for the cultural heritage of the country. Most recently in May 2019 Royal Decree No 35/2019 updates the national Cultural heritage law, replacing the National Heritage Protection Law of 1980[122].

6.13.1.1 International Conventions and Protocols

The Sultanate of Oman has ratified or accepted a number of international conventions and protocols in relation to Cultural Heritage. These include the following:

- Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict with Regulations for the Execution of the Convention (1954) on 26 October 1977;
- UNESCO Agreement on the Importation of Educational, Scientific and Cultural Materials, with Annexes A to E and Protocol annexed (1950) on 19 December 1977;
- UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (1970) on 2 June 1978;
- UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972) on 6 October 1981;
- UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003) on 4 August 2005;
- UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005) on 16 March 2007;
- Second Protocol to the Hague Convention of 1954 for the Protection of Cultural Property in the Event of Armed Conflict (1999) on 16 May 2011.

6.13.1.2 Oman Cultural Heritage Laws

Oman laws and regulations of particular relevance to the project include, but are not limited to[123]:

- Decree of the Sultan No 35/2019 on the Cultural Heritage Law, 2019;
- Ministerial Decision regarding the list of Museums and Heritage Institutions (2010)
- Ministerial Decision regarding the organizational list of religious recital groups (2010)
- Decree on the adoption of the Cultural Diversity Convention (2007)
- Decree of the Sultan on the adoption of the UNESCO Convention of Safeguarding of the Intangible Heritage (2005)
- Law on the control of Art Circulation (2005)
- Decree of the Sultan n.24/2005 on the functions and structure of the Ministry of Heritage and Culture (2005);

[122] https://www.omanobserver.om/royal-decree-promulgates-cultural-heritage-law/
[123] https://whc.unesco.org/en/statesparties/om/laws/

- Decree of the Sultan n.65/1997 on the adoption of a law to control Art Traffic (1997);
- Law on the protection of national cultural heritage, 1980 (superseded in 2019);
- Decree of the Sultan N.20/77 on the functions of the Ministry of National Heritage, 1977
- Law on the censorship of works of artistic composition (1977);
- Law on the protection of Manuscripts (1977).

The Decree of the Sultan No 35/2019 on the Cultural Heritage Law, 2019 has recently been introduced to replace the previous law of 1980.

- Article (1) states that the Cultural Heritage Law attached to this decree shall be enforced.
- Article (2) stipulates that the Minister of Heritage and Culture shall issue the executive regulation (bylaw) for the Cultural Heritage Law within one year from its date, as well as necessary decisions for enforcing its provisions. Till the issuance of the bylaw and decisions, the existing regulations and decisions shall continue to be implemented, but without prejudice to the provisions of the (new) law.
- Article (3) cancels the National Heritage Protection Law (1980) promulgated under Royal Decree No 6/80, as well as all that contradicts the Cultural Heritage Law or contravenes its provisions.
- Article (4) says that this decree shall be published in the Official Gazette and enforced on the day following its date of publication.

6.13.1.3 State Regulator - Ministry of National Heritage and Culture

In 1977 the Ministry of National Heritage and Culture was created[124] as the state regulator for heritage. The Ministry is obligated to protect tangible as well as intangible property — such as traditional professions, scientific and intellectual achievements — and to safeguard national traditions. The ministry issues licences which are legally required for archaeological excavations. All excavated movable cultural property must be reported to administrative authorities and is considered to be State property. The Ministry also maintains a listing (inventory) of all movable cultural heritage.

6.13.1.4 IFC Performance Standard 8 (Cultural Heritage)

There is an increasing array of international standards relating to the protection of cultural heritage. Among the most widely applied is IFC Performance Standard 8 (PS8), developed to set out minimum requirements for the protection of cultural heritage resources in development projects supported by the IFC. The objective of the PS 8 is to ‘protect cultural heritage from the adverse impacts of project activities and support its preservation [and] promote the equitable sharing of benefits from the use of cultural heritage.’

PS 8 differentiates between replicable, non-replicable, and critical cultural heritage, which are defined as follows:

- Replicable Cultural Heritage: Defined as ‘tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.’
- Non-replicable Cultural Heritage: Includes ‘(i) cultural heritage [that] is unique or relatively unique for the period it represents; or (ii) cultural heritage [that] is unique or relatively unique in linking several periods in the same site.’

[124] https://whc.unesco.org/en/statesparties/om/laws/

Critical Cultural Heritage: Includes '(i) the internationally recognized heritage of communities who use or have used within living memory the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designation.'

The preferred mitigation measure for all cultural heritage impacts is avoidance. When this is not possible, PS 8 provides the following mitigation hierarchy (from preferred to least preferred) for replicable cultural heritage:

- Minimize adverse effects and implement in situ restoration measures;
- Restore the functionality of the cultural heritage in a different location;
- Permanent removal of historical and archaeological artefacts following national laws and internationally recognized practices by competent professionals; and
- Compensation for the loss of cultural heritage.

The removal of non-replicable cultural heritage should only take place if there is no technically or financially feasible alternative and the benefits of the project outweigh any heritage losses. The removal of critical cultural heritage should only take place in 'exceptional circumstances' and after extensive consultation with affected communities and other stakeholders.

6.13.2 Overview of Cultural Heritage in Oman

6.13.2.1 Prehistoric Period

It is currently believed that all of Arabia was settled in prehistory, but up until recent times most of our information has come from coastal locations, with many inland areas having seen no research. Much archaeological work in Oman to date has tended to consist of surface survey. However in the geographical context of the country, that has proved to be a most effective form of investigation.

Published data suggest a very early occupation in the southern part of Oman dating back to about one to 1.5 million years (Whalen et al 2002, Whalen 2003), although this is currently controversial.

There is currently no evidence from the middle or upper Acheulean periods in Oman (c.900000 to 300000 years ago), although sites in neighbouring Saudi Arabia and Yemen suggest Southern Arabia was settled at that time.

Some evidence suggests that Oman may have had some presence of Levallois culture groups, (c.250000 to 45000 years ago). The Levallois-technique was a particular method for producing characteristic and standardised flakes which drastically changed prehistoric tool-kits. However evidence is limited and it may be towards the end of the phase (c.90000 to 70000 years ago).

Archaeological surveys have revealed a human presence in Oman stretching back to the Late Pleistocene. A site at Aybut Al Auwal, which produced Late Nubian complex stone tools, has been dated to 106,000 years old, possibly representing the first evidence of human settlement into Arabia from Africa.

The Pleistocene in Oman can be seen in the form of a local culture producing hand axe tools made in a very basic style called Heavy Bifacials. Before the end of the Pleistocene (c.15 – 20,000 years ago), the Heavy Bifacials material culture changed and developed into what is known as the Arabian Bifacial Tradition of the Neolithic. The diverse sizes of tools suggest a wide range of functions, not only as weaponry but also for domestic use. The Arabian Bifacial Tradition, characterised by exquisitely worked arrowheads, is thought to have originated from indigenous populations already present in Southern Arabia, rather than an influx of immigrants.

The earliest discoveries of domesticated animals in Oman date to about 7,000 years ago. However a dramatic change in climate may have prevented the establishment of herding and farming to areas beyond the coastal strip, and the hunter and gatherer tradition could have persisted in central lands up to relatively recent times. The earliest known settlements in Oman date from the Middle Holocene (c. 7,800 years ago) concentrated along the coasts of the Indian Ocean. Staple food was provided by fishing and collecting marine mussels and snails, evidence for which can be seen in shell middens along the coast.

Towards the end of the Arabian Neolithic (c.5000 years ago), Oman was populated with neighbouring peoples. Naturally rich copper ores attracted populations and led to the emergence of the Falaj culture, notable for its use of irrigation for producing food on a large scale. This Bronze Age era also produced wheel-turned pottery, stone vessels, and saw the emergence of monumental architecture. The Falaj culture was well established by the time of the Iron Age (c.3000 years ago) but was still involved in the production of sophisticated stone tools, suggesting an attachment to long standing traditions despite the discovery and development of metal.

6.13.2.2 Historic Period

The northern half of Oman was part of the Maka satrapy of the Persian Achaemenid Empire (2,500 – 2,000 years ago) founded by Cyrus the Great. From c. 100 BCE to c. 300 CE Semitic speakers appear for the first time in central Oman at Samad al-Shan. The Kingdom of Oman was subdued by the Sasanian Empire's forces under Vahrez during the Abysinian-Persian Wars.

Oman first encountered Islam in 630, and consolidation took place in the Ridda Wars in 632. An imamate in Oman was established in 751 by Ibadi Muslims, and this survived until the mid-20th century. In 1154, the Nabhani dynasty came to power and ruled Oman until 1470. During the colonial period, Portugal dominated the area around Muscat between 1507 and 1650. The Portuguese took Muscat on 1 April 1515, and held it until 26 January 1650, although the Ottomans briefly took over from 1550 to 1551 and from 1581 to 1588. During the Yarubid Imamate, the Portuguese were driven out of the region, turning the Omani Yarubid dynasty in to a colonial power by acquiring former Portuguese colonies in east Africa and engaging in the slave trade, centered on the Swahili coast and the island of Zanzibar

In the late 17th century Oman became a powerful regional trading power based on maritime trade. Saif bin Sultan expanded the empire down the east coast of Africa profiting from the slave trade. Oman held the island of Zanzibar on the Swahili Coast, the Zanj region of the East African coast, including Mombasa and Dar es Salaam, and (until 1958) Gwadar on the Arabian Sea coast of present-day Pakistan

In 1798, Oman and Great Britain signed a Treaty of Friendship. A succession crisis in 1856, however, saw the Omani Empire divided into the Sultanate of Oman and Muscat and the Sultanate of Zanzibar. In 1891, Oman and Muscat became a British Protectorate. For much of this period, the Sultan controlled the coast around Muscat while the Imam governed the interior from Nizwa. Under the 1951 Treaty of Friendship, Commerce and Navigation, Oman received independence from Britain.

6.13.2.3 North Al Batinah and Sohar

The project site lies within the North Al Batinah region of Oman, close to the historic town of Sohar. Sohar is one of the oldest towns in Oman, and for many centuries was the most important port and commercial centre until it was supplanted by Muscat from the sixteenth century onwards. Its origins date back about 2,500 years and was a centre for smelting and mining the copper mines of Wadi Jizzi and was the centre of an extensive trading network stretching up and down the Gulf. Sohar was the capital of Oman before Islam, called 'Majan'. It has also been identified with the ancient town called 'Omanah' mentioned by Pliny the Elder in his Natural History. The town gave Oman its name.

With the arrival of Islam about 1,400 years ago, Sohar was already established as the capital of the region, profiting from its geographical position. Sohar has been identified as the mythical birthplace of Sinbad the Sailor. Historical sources (Al Makdessi) described Sohar in the tenth century as "a thriving city with a large population and a beautiful city providing comfortable living. Its impressive residential districts spread along the beach, and its towering buildings are built with baked brick and teak wood."

Sohar was attacked by the Persians in 971 and 1041, being overrun and largely destroyed by both events. In 1276 about 5000 Mongol raiders from Shiraz arrived and delivered a similar fate but recovered to some extent by the time Marco Polo visited c.1293. The Portuguese occupied Sohar in 1507 and controlled the city until 1643, before being evicted by the Omani forces of Nasir bin Murshid. In 1738 the Persians of Nadir Shah attacked Sohar but were repelled by Ahmad bin Said, the city's governor who would go on to become ruler of Oman. A further nine-month Persian siege in 1742 this time say the city fall to the attackers. Following this, Sohar was gradually eclipsed by Muscat as the country's major seaport and centre of power.

Source: Map by James Wellsted, published by the Journal of the Royal Geographical Society, London by John Murray. London 1837

Figure 6-35 Map of the Region of Sohar

6.13.3 Identified Heritage Sites within the general area

Several natural and cultural heritage sites are identified in the Master Plan for Al Batinah Coastal Area prepared by the Supreme Council of Planning. These include the following:

- Sohar urban heritage assets: Burj Woqaibah and Sohar Fort;
- Liwa Fort;
- Harmool village and Khawr Nabr, Sohar Wilyat;
- Hawrat Bargha fortress and surrounding features including Lasail mine and Wadi Jizzi
- Rehab village, Sohar Wilyat;
- Fazah Castle and Fizh village, Sohar Wilyat.

Three of these sites are presented in Figure 6-36. None of these sites will be directly impacted by the proposed development. As already indicated, the project site will consist of future reclaimed land in Sohar Port which has been constructed to accommodate brownfield development.

Liwa Fort, ~ 7km North West of the Project site. Source: ERM Field Survey, November 2019

Sohar Fort, ~ 18 km South West of the Project site. Source: www.inspirock.com; accessed: 29.01.2020

Fazah Fort, ~19k west of the project site: source: www.welcometooman.om; accessed: 30.01.2020

Figure 6-36 Example of Local Identified Heritage Sites

7 STAKEHOLDER ENGAGEMENT

7.1 Introduction

This section provides a description of the main stakeholders of relevance to the Project and a summary of previous stakeholder engagement activities undertaken. Additionally, the section provides an overview of the stakeholder engagement programme that will be implemented by the Project. This programme is designed to cover all phases of the Project. The Community grievance mechanism's purpose and procedure is also summarised. This section is complemented by the Project's Stakeholder Engagement Plan (ERM, 2023) presented in Appendix B.

7.2 Stakeholder Engagement Principles

Engagement with external stakeholders and communities is an integral requirement of MARSA LNG LLC's societal approach as set out in in the Societal Policy, Societal Directive and Company Rule. As part of MARSA LNG LLC's societal commitment to create value for local communities, the Company aims to build constructive, sustainable relationships with stakeholders, whose support is seen as a key factor in the success of the Company's business. MARSA LNG LLC's community engagement approach is based on:

- Nurturing dialogue with local residents and public and private sector stakeholders;
- Managing the impact of the Company's operations; and
- Contributing to local human, cultural and economic development.

Indeed, MARSA LNG LLC believes that addressing local stakeholders' development priorities and listening to their concerns is key to strengthening the Company's integration into the local community and growing the businesses over the long term. Continuous dialogue helps all parties understand each other's expectations and builds mutual trust.

MARSA LNG LLC understands that effective stakeholder engagement and public consultation is a cornerstone of successful Project development. Therefore, the Company has developed principles for stakeholder engagement to be applied. The principles are based on international best practice guidance and E&P Societal standards.

The key principles guiding MARSA LNG LLC's approach to stakeholder engagement on this Project are:

- Open and Transparent: Information relevant to affiliate activities should be accessible and transparent as possible, providing stakeholders with a comprehensive understanding of Project Activities and how they are or may be affected by them (unless legitimate reasons for commercial confidentiality or the protection of stakeholders required it be kept confidential)
- Listening and Dialogue: Stakeholders should be listened to, their concerns taken seriously, and responses provided in a timely manner to address their concerns.
- Participation: Stakeholders are invited and encouraged to actively engage with the affiliate and its consultants. The affiliate should be inclusive in this process taking into account factors such as gender and cultural considerations and ensuring all stakeholders feel they have an opportunity to share their perspectives.
- Proactive: Relationship-building takes time; start the engagement process early. Provide information in advance of consultation activities and decision-making points. Ensure that potential risks and impacts are communicated proactively with stakeholders.
- Impact-focused. During the impact assessment process, engagement with PACs is focused around the potential and actual negative project impacts that may concern them in order to jointly identify appropriate avoidance and mitigation measures. Other stakeholders indirectly affected by Project impacts are also consulted.

- Safe Participation: Steps are taken by the Company towards ensuring any stakeholder that participates in any form of engagement can do so in a safe and protected manner without risk or fear for retaliation (for example through the use of trusted third parties, individual meetings or group meetings)
- Effectiveness: Information and forms of engagement should be acceptable and effective for the individuals for whose use they were intended. Information and forms of engagement should be accessible, legitimate, transparent and Human Rights-compatible.
- Appropriate form of engagement: Different forms of engagement may be required for different kinds of stakeholders and different purposes. Information provided to stakeholders should be provided in an appropriate format to the stakeholder in question considering the potential need to provide assistance for the interpretation of technically complex information. Wherever possible, stakeholders should be engaged directly. Where this is not possible because it may threaten their safety, engagement should occur through legitimate and credible representatives.
- Empowering and responsive: Engagement should empower stakeholders to make their voices heard. This includes clearly informing stakeholders of what they can expect in terms of feedback and responses to their inputs.
- Equal and Human Rights respectful: Everyone, without discrimination, has the right to participate on equal terms. This includes a responsibility for the affiliate or entity to ensure a gender sensitive approach to engagement is implemented and to identify the need for any special measures to ensure that vulnerable individuals and groups are inclusively engaged.

7.3 Stakeholder Identification

Stakeholders include individuals or groups that may influence or be impacted by the Project, described as follows:

A stakeholder is any person, group of persons, or organization on which the Project (or activity) has an actual or potential, direct or indirect, positive or negative impact, or one that has an actual or potential, direct or indirect, positive or negative impact on the Project (or activity).

The level of interest and impact of any given group of stakeholders is dependent on a number of factors including level of authority, socio-economic context, influence, education and cultural factors.

Stakeholder identification began at Project inception and planning and has continued through the various stages of the Project development.

Stakeholders identified to date represent the organisations and individuals who may be directly or indirectly (positively or negatively) affected by the Project or who may have an effect on how the Project is implemented.

Stakeholders identified to date for inclusion in engagement activities meet one of the following criteria:

- Have an interest in the Project;
- Would potentially be impacted by or have an influence on the Project (negatively or positively); and/or,
- Could provide commentary on issues and concerns related to the Project.

Stakeholders were categorised, based on their various needs, interests, and potential influence on the Project as outlined in Table 7-1 below.

Table 7-1 Stakeholder Category List

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
Central Government Authorities (Ministries in Muscat and/or their Regional Offices)	Central Government is of primary political importance to the Project in terms of establishing policy, granting permits or other approvals, and monitoring and enforcing compliance with Omani Law throughout all stages of the Project life-cycle.	Ministries and Directorate General offices of relevant Ministries: ■ Environmental Authority (EA) ■ Ministry of Labour ■ Ministry of Transport, Communications and Information Technology ■ Ministry of Social Development (MoSD) ■ Ministry of Agriculture, Fisheries and Water Resources (MAFWR) ■ Ministry of Health ■ Ministry of Heritage and Tourism ■ Ministry of Education ■ Ministry of Housing and Urban Planning ■ Ministry of Justice and Legal Affairs ■ Directorate General (DG) offices of Ministries. ■ Civil Defence and Ambulance Authority (PACD)
Governorate and Local Government Authorities	The Governorate and Local Government (Majlis Al Shura and Wali) are of importance to the Project as they are responsible for implementation of legislation, and development plans and policies at the Governorate/Wilayat level. The Majlis Al Shura constitute the Consultative Assembly of the Central Government of Oman. The Consultative Assembly has 83 elected members (Shura Members) drawn from Oman's 59 Wilayats. The Wali are designated by the Central Government (Ministry of Interior) and are the head of the sheiks. There is one Wali per Wilayat (district of a Governorate). They are key leadership figures at local level.	■ Wali of Liwa ■ Wali of Sohar ■ Council Representatives ■ Majlis Al Shura Representatives ■ Governor of North Al Batinah Governorate (note: the Wali of Sohar is the acting Governor at the time of writing). ■ Sohar Local Municipality (previously known as Sohar Development office, reporting to the Diwan of Royal Court) ■ Liwa Local Municipality
Local Community Representatives (Sheiks)	The Sheiks are elected local community leaders acting as representatives of their local community (at settlement level). Elected sheikhs are likely to be from the dominant tribe within the community. They are key leadership figures at local level.	■ Sheikhs of settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghuzzayyil, Al Hadd, Wadi Al Qasad, Uqdat Al Mawani, Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul.
Public company	SIPC is the Project's main stakeholder to engage with, in terms of granting the ESIA approval, and coordinating level of engagement during the Project lifecycle.	■ Sohar Industrial Port Company (SIPC)
Local Institutions (Public services)	Local public services including educational, health and law enforcement related stakeholder that potentially may be directly or indirectly affected by the Project activities or the Project's associated social and environmental impacts.	■ Government health centers ■ Law enforcement: Royal Oman Police ■ Law enforcement: Royal Omani Police (Traffic Department)

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
		■ Law enforcement: Royal Oman Police (Coastal Guard) ■ Law enforcement: Royal Oman Police (Customs and Immigration) ■ Public educational centers ■ Prosecutor office in Sohar and Liwa
International agencies	Organizations with direct interest in the Project, and its social and environmental aspects, and that are able to influence the Project directly or through public opinion. Such organisations may also have useful data and insight and may potentially become partners to the Project in areas of common interest such as the implementation of community investment or CSR projects if applicable.	■ International agencies with offices in Muscat: UNICEF, WHO, FAO, UNFPA
Civil society	Organizations with direct interest in the Project, and its social and environmental aspects, and that are able to influence the Project directly or through public opinion. Such organisations may also have useful data and insight and may potentially become partners to the Project in areas of common interest such as the implementation of community investment or CSR projects if applicable.	■ General Federation of Oman Trade Unions ■ Human Rights Commission Office ■ Jusoor – CSR Organization Sohar ■ Environment Society of Oman ■ Omani Women's Association Sohar ■ Omani Women's Association Liwa ■ Indian Social Club Sohar ■ Sohar Sports Club ■ Omani Network of Fishing Hobbyists Sohar ■ Takafol Sohar ■ Hassad Liwa
Businesses	Private sector industries and companies that may be affected directly or indirectly affected by the proposed Project and its activities. The businesses Vale, Sohar Aluminium and OQRPI are also tenants of the Sohar Port.	■ Vale ■ Sohar Aluminium ■ OQRPI ■ Private health clinics ■ Private educational centers ■ Port Contractors (e.g. Al Bahwan Group)
Potentially affected communities/groups	Communities may be directly or indirectly affected by the proposed Project and its activities. These communities need to be made aware of the Project's schedule and its planned activities as well as of the potential benefits that will come in the form of employment and Community Investment or CSR if applicable.	■ Fishermen in Majis, Liwa, Harmul ■ Farm owners in Majis ■ Communities living in the settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghazzayyil, Al Hadd, Wadi Al Qasad, Uqdat Al Mawani, Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul. ■ Expatriate workers
Vulnerable groups	Vulnerable groups may be affected by the Project by virtue of their social or economic standing, limited education, lack of employment or access to land.	■ Vulnerable groups living in the settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghazzayyil, Al Hadd, Wadi Al Qasad, Uqdat Al Mawani,

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
		Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul: ■ Very poor households ■ Women and Female-headed households ■ Unemployed youth ■ Elderly and orphans ■ Disabled persons ■ Children
Academia and Education institutions	Education institutions and individuals with direct interest in the Project, and its social and environmental aspects and that are able to influence the Project directly or through public opinion. Such organizations may also have useful data and insight and may be able to become partners to the Project in areas of common interest. Potential partners' interests lie in the provision of services and supplies to the Project.	■ National Training Institute (National Office with a branch in Sohar) ■ Danna Training Services (Local) ■ International Maritime College (Local) ■ Sohar University (Local)
Media	Local, regional and national level media will typically have a higher level of influence over the Project and may be leveraged to influence local stakeholders' perceptions of the Project.	■ Media: Arabic and English newspapers

Source: ERM, 2020

7.4 ESIA Consultation Activities

As part of the Project disclosure and social baseline data collection for the ESIA, extensive stakeholder engagement was undertaken.

7.4.1 Baseline phase stakeholder engagement

Engagement as part of the ESIA process was conducted during the 9-day field survey from 27th to 31st October and 3rd to 6th November 2019 and was led by a combined 5OES/ERM Team.

The purpose of the field survey was:

- To collect specific socioeconomic, health, and human rights data at the local level to the extent available and at the Wilaya level; and
- To establish initial contact with key stakeholders in Muscat and Sohar and introduce the Project.

The data collection process was guided by the key issues and information gaps identified during the desktop review process and described in the Bibliographic Baseline Study prior to the field survey. Data collection stakeholder engagement activities consisted primarily in Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and settlement profiling activities. This process was primarily qualitative in nature.

The primary objectives of the baseline stakeholder engagement activities were to:

- Briefly present the Project to stakeholders;
- Collect socioeconomic and health information at the settlement level to the extent available and at Wilayat level in order to collect more detailed information on specific issues identified during the scoping desktop review; and
- Document stakeholder opinions, questions, concerns and expectations to assist in defining the terms of reference and inform the scope of the ESIA.

As part of the engagement process two separate meetings were held with the Walis of Liwa and of Sohar and other local government representatives to disclose basic Project information and collect feedback on the Project and request baseline data. Additionally, over 35 meetings with key governmental and non-governmental stakeholders at the national, regional and local levels were also organised.

Meetings held in Muscat during that same timeframe focused on national level stakeholders and included central ministry offices and relevant non-governmental organizations, while data collection activities in Sohar focused on regional and local level stakeholders including regional ministry offices, local government representatives, local community members and associations, expatriate worker representatives, and relevant public and private institutions

National level data collection efforts continued after the field survey. Specifically, follow-up data requests were sent to the points of contact at the relevant ministries to collect more quantitative data on specific aspects. However, it should be noted that at the time of writing, most of these requests were not answered and some data gaps still remain. National level data collection is expected to continue until the submission of the Environmental and Social Impact Assessment (ESIA) report through follow up information requests and clarifications as required.

At the local level, the social baseline data collection meetings were conducted as individual meetings with relevant local government ministry representatives (i.e. DG of Labour for Al Batinah North, Regional Office of Agriculture and Fisheries, Sohar Municipality, etc.) groups of non-governmental stakeholders (i.e. business associations, fishermen representatives, women's associations, etc.), and community members (i.e. fishermen and farmers).

At the start of every meeting, a high-level introduction about the Project and the ESIA process was provided as a means to inform stakeholders It was followed by a discussion on various topics, including but not limited to: community health, infrastructure and public services, livelihoods (agriculture and fishing), employment, worker issues, gender issues, cultural change, health and education, recommendations and opinions from those stakeholders met and a review of the follow-up data collection actions agreed.

See Appendix A of the Stakeholder Engagement Plan (provided as Appendix B of this ESIA) for details on the baseline stakeholder engagement activities carried out (date, participants and objectives of each meeting).

7.4.2 Scoping Presentation Meeting

Two additional meetings with were organised with SIPC and the Port of Rotterdam[125].

The meeting to present the results of the Scoping Report to SIPC was held on 22nd January 2020. This meeting served to inform SIPC of the final project design, preliminary results of the scoping impact assessment and preliminary proposed mitigation measures. The key outcomes of the social baseline data gathering were summarised and were the following:

- The common concern raised from all communities was regarding odours which they link to perceived poor air quality caused by port emissions. Concerns regarding the impacts of Air Quality on health were also raised.
- The main complaint from fishermen was regarding decreased access to fishing grounds caused by the port.
- Other recurring social concerns were regarding high unemployment rates in the youth despite developments in the port area.

A second scoping meeting was organized on 4th March 2020 with representatives of the Port of Rotterdam. This meeting served to present the results of the Scoping Report and to align expectations on the contents of the ESIA, Safety package and QRA.

7.4.3 ESIA Disclosure and Consultations

The final ESIA Report (version C), as updated in 2023, in English language along with a Non-Technical Summary in Arabic language, was made available to stakeholders and general public for a period of 39 calendar days (from 11 December 2023 to 18 January 2024). The disclosure was facilitated through electronic access via a link [https://totalenergies.com/oman/marsa-lng-project-environmental-and-social-impact-assessment-esia], accessible through a QR code, as well as through hardcopies. The availability of the ESIA report for public consultation was announced through two announcements posted in the Al Shabiba newspaper, in Arabic language, as follows:

- Announcement on 11 December 2023 when hardcopies of the ESIA report and feedback forms were made available to the public, indicating where the ESIA was available for review and soliciting feedback – see Figure 7-1 below.

[125] The Port of Sohar is managed by SIPC, which is a 50% - 50% joint venture between the Port of Rotterdam and the Sultanate of Oman.

Figure 7-1 Public announcement in Al Shabiba newspaper on 11 December 2023

دعوة عامة لتقديم التعليقات حول دراسة التقييم البيئي
والاجتماعي لمشروع مرسى للغاز الطبيعي المسال

تدعو شركة مرسى للغاز الطبيعي المسال ش م م عامة الناس لتقديم التعليقات والملاحظات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى لتزويد السفن بالغاز الطبيعي المسال.

تعتزم شركة مرسى للغاز الطبيعي المسال، وهي شركة مشتركة بين توتال إنرجيز وشركة المزن للغاز الطبيعي المسال ش م م (التابعة بالكامل لمجموعة او كيو) (OQ)، تطوير محطة للغاز الطبيعي المسال في منطقة ميناء صحار الصناعي. ستقوم المحطة بتوفير الغاز المسال كوقود للسفن البحرية. وكجزء من عملية الحصول على تصريح بيئي، تم إعداد دراسة تقييم بيئي واجتماعي لتقديمها إلى الجهات العمانية المختصة.

تماشيًا مع أفضل الممارسات الدولية، يسعى المشروع إلى الحصول على تعليقات وملاحظات حول نتائج دراسة التقييم من جميع أصحاب العلاقة من الحكومة وعامة الناس. لذلك يُدعى الجمهور للاطلاع على التقرير البيئي والاجتماعي وتقديم تعليقاتهم وملاحظاتهم.

ستمتد فترة الإفصاح لمدة ثلاثين (٣٠) يومًا ابتداءً من ١١ ديسمبر ٢٠٢٣ إلى ١١ يناير ٢٠٢٤. خلال هذه الفترة، سيتم وضع نسخة واحدة من تقرير التقييم البيئي والاجتماعي، ونسخ متعددة من الملخص غير التقني، واستمارات التعليق في ثلاثة مواقع، وهي مكتب محافظ شمال الباطنة، ووالي صحار، ووالي لوى ، متاحة لعامة الناس.

يمكنكم الاطلاع على تقرير التقييم البيئي والاجتماعي الشامل على موقع
https://totalenergies.com/oman ، أو عن طريق مسح رمز الـQR. يمكنكم أيضا
تقديم التعليقات باستخدام عنوان البريد الإلكتروني للمشروع
esia.grm@totalenergies.com

شاكرين لكم حسن تعاونكم ومشاركتكم.

Source: 5OES, December 2024

- Announcement on 4 January 2024 refreshing information about the ESIA availability for public review and soliciting feedback – see Figure 7-2 below.

Figure 7-2 Public announcement in Al Shabiba newspaper on 4 January 2024

دعوة عامة لتقديم التعليقات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى للغاز الطبيعي المسال

تدعو شركة مرسى للغاز الطبيعي المسال ش م م عامة الناس لتقديم التعليقات والملاحظات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى لتزويد السفن بالغاز الطبيعي المسال.

تعتزم شركة مرسى للغاز الطبيعي المسال، وهي شركة مشتركة بين توتال إنرجيز وشركة المزن للغاز الطبيعي المسال ش م م (التابعة بالكامل لمجموعة او كيو)(OQ)، تطوير محطة للغاز الطبيعي المسال في منطقة ميناء صحار الصناعي. ستقوم المحطة بتوفير الغاز المسال كوقود للسفن البحرية. وكجزء من عملية الحصول على تصريح بيئي، تم إعداد دراسة تقييم بيئي واجتماعي لتقديمها إلى الجهات العمانية المختصة.

تماشيًا مع أفضل الممارسات الدولية، يسعى المشروع إلى الحصول على تعليقات وملاحظات حول نتائج دراسة التقييم من جميع أصحاب العلاقة من الحكومة وعامة الناس. لذلك يُدعى الجمهور للاطلاع على التقرير البيئي والاجتماعي وتقديم تعليقاتهم وملاحظاتهم.

بدأت فترة الإفصاح في تاريخ ١١ ديسمبر وستمتد لمدة ثلاثين (٣٠) يومًا وستنتهي في تاريخ ١٨ يناير ٢٠٢٤. خلال هذه الفترة، سيتم وضع نسخة واحدة من تقرير التقييم البيئي والاجتماعي، ونسخ متعددة من الملخص غير التقني، واستمارات التعليق في ثلاثة مواقع، وهي مكتب محافظ شمال الباطنة، ووالي صحار، ووالي لوى ، متاحة لعامة الناس.

يمكنكم الاطلاع على تقرير التقييم البيئي والاجتماعي الشامل على موقع

https://totalenergies.com/oman ، أو عن طريق مسح رمز الـ QR. يمكنكم أيضا تقديم التعليقات باستخدام عنوان البريد الإلكتروني للمشروع
esia.grm@totalenergies.com

شاكرين لكم حسن تعاونكم ومشاركتكم.

Source: 5OES, January 2024

In addition to the disclosure in electronic form, one hardcopy of the ESIA Report (version C) in English, ten hardcopies copies of the NTS in Arabic, fifty hardcopies of the feedback form in Arabic, a sheet displaying the QR code for electronic access to the ESIA, a poster to attract attention and indicate the availability of materials, a box of fifty ballpoint pens, and a feedback collection box were made available at each of the following locations:

- Office of the Governor of North Al Batinah located at North Al Batinah Governor Office, Al Bahja St, Al Hambar, Sohar, P.O. Box: 341, Postal Code: 311;
- Wali Office in Liwa GHG6+V85; and

  Wali Office in Sohar located at P.O. Box: 261, Postal Code: 311, 9Q72+42Q, Sohar.

This ensured that stakeholders with limited digital literacy also had the opportunity to learn about the Project and provide feedback. The documents were placed in areas overseen by the institutional security to prevent damage or unauthorized removal of the materials.

Figure 7-3 View of the ESIA package available in the office of the Governor of North Al Batinah

Source: 5OES, December 2023

Additional means which were made available to stakeholders to provide feedback on the ESIA included:

- Using feedback forms which were available to participants in the disclosure meetings.
- Calling or sending WhatsApp messages to the phone number: 00968 9200 8157, during the entire ESIA disclosure period;
- Electronic communication, via email at esia.grm@totalenergies.com, during the entire ESIA disclosure period.

Anonymous feedback was also accepted.

In addition to making the ESIA available for public review, the disclosure meetings presented in Table 7-2 below were held:

Table 7-2 Overview of ESIA disclosure meetings held in January 2024

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
Monday, 8th January 2024					
11:00 – 12:30	Omani Women Association building, Liwa	Informal meeting	Omani Women's Association – Liwa	15 (all women)	Meeting attended exclusively by women
13:00 – 15:00	Lathaeth Sohar, Sohar	Informal meeting	Youth/ Charity Groups of Sohar and Liwa	5 (no women)	

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
18:30 – 20:00	Omani Women Association building, Sohar	Informal meeting	Omani Women's Association – Sohar	2 (all women)	Meeting attended exclusively by women
20:30 – 22:00	AL-Moazzeb Jordanian, Sohar	Informal meeting	Fishermen community of Sohar and Liwa	5 (no women)	Meeting organised after the 'Isha prayer (Islamic prayer) and to allow for people to travel to the venue
Tuesday, 9th January 2024					
08:30 – 10:30	Wali's office, Liwa	Formal meeting	■ Wali of Liwa, ■ Representatives of the Majlis Ashura ■ Representatives of Liwa municipal council ■ Sheikhs of communities in the Project's area of influence	9 (no women)	
11:30 – 13:30	Majan Hall, Sohar	Formal meeting	■ Deputy Wali of Sohar, ■ Representatives of the Majlis Ashura ■ Regional offices of concerned ministries: Environmental Department of North Al Batinah Government, Head of Labour Affairs North Al Batinah, Head General of Health Services North Al Batinah ■ Sheikhs of communities in the Project's area of influence	11 (no women)	

Source: ERM and 5OES, January 2024

The above-mentioned disclosure meetings intended to present the Project, the results of the impact assessment and defined mitigation measures as well as the Project's Grievance Mechanism to governmental stakeholders as well as non-governmental stakeholders, using a PowerPoint presentation and a Non-Technical Summary (NTS) in Arabic. They allowed collecting feedback, comments, concerns and recommendations from stakeholders on the Project's potential impacts and proposed mitigation measures. The meetings were also used to feedback to stakeholders on how their concerns gathered during the baseline stakeholder engagement carried out in 2019 have been taken into account for the development of the SBS report and informed the scope of the ESIA.

During the disclosure process, a total of seven written feedback forms were received, out of which two in Liwa and five in Sohar. Additional feedback was received through Whatsapp and included two employment applications. No feedback was received via email or phone.

Table 7-3 below presents an overview of the key feedback received during the ESIA disclosure meetings held in January 2024 and indicates how this was considered in the final version of the ESIA (version D). Detailed minutes of the disclosure meetings held are provided in Annex B to this SEP.

Table 7-3 Overview of the key feedback received during the ESIA disclosure phase held in January 2024

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
Employment	Stakeholders in all meetings mentioned their expectations that the Project should prioritise employment local job seekers from the wilayats of Liwa and Sohar. Expectations also referred to access to long-term employment opportunities.	■ Wali Liwa office ■ Wali Sohar office ■ OWA, Liwa ■ OWA, Sohar ■ Charity Teams ■ Fishermen community ■ General public	■ Verbally during public disclosure meetings. ■ Written feedback forms.	Employment impacts are addressed in Section 8.6.1 of the ESIA. As a result of the ESIA disclosure, the enhancement measures for local economy and employment were supplemented with the following: 'To facilitate access to employment opportunities for local candidates (within the wilayats of Liwa and Sohar) with appropriate skill sets, a database of people looking for work will be maintained and will identify the candidates' place of origin'.
Environmental, Health and Social Impacts	Stakeholders shared concerns about the potential negative impacts of the Project such as the presence of flare and the potential impact of gas emissions on air quality, potential gas pipe leakage and the risk of explosions, or odour. Stakeholders also used the opportunity of the ESIA disclosure meetings to raise general concerns which were perceived to be attributable to the current industrial operations within the Sohar Industrial Port Area (SIPA). Examples included perceived increased incidence of health issues, such as cancer and miscarriages, reporting of deposition of white powdery residues on cars, trees, noise from industrial activities and operations including but not limited to jetty hammering and flaring, waste impacting local villages. The participants claimed that the industrial operations in the SIPA are adversely impacting fishing activities, particularly in Harmul, located approximately 200 meters from the port.	■ Fishermen community ■ Wali Liwa office ■ General public ■ OWA, Liwa	■ Verbally during public disclosure meetings. ■ Written feedback forms.	The Project's environmental impacts are addressed in Section 8.5 and relevant mitigation measures defined. As indicated in the ESIA Section 8.6.5.4, MARSA LNG LLC will: ■ communicate to affected stakeholders the progress on meeting the Project's environmental and socioeconomic commitments during the construction phase through, at a minimum the release of quarterly performance reports which will be posted on the Project website; ■ agree with government and other stakeholders the scope of third-party monitoring, which might involve local stakeholder representatives, in assessing whether social and environmental impact mitigation measures and other intended benefits are as effective as anticipated. The reports of the third-party monitoring will be made available to the public through MARSA LNG LLC website;

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
	There was a demand for increased transparency of the environmental monitoring results associated to industrial operations within the Sohar Industrial Port Area to local neighbouring communities.			■ involve affected stakeholders or third-party representatives in monitoring of the Project's socioeconomic and environmental performance for issues of great interest to the public. No changes were deemed necessary to the ESIA.
Project Social Investment and Responsibility	Social investment initiatives from Sohar port companies are perceived to be very small compared to the companies' revenue. Expectations in terms of access to benefits from the Project were raised by the majority of stakeholders who complained. Benefits should be directed to impacted villages around SIPA, particularly Harmul and Ghadhafan, without involving intermediaries or third parties. Requests were made for the Project to support the local community, including fishermen, sports clubs and charity teams as well as the OWA in Liwa and to prioritise partnerships with local SMEs.	■ Wali Sohar ■ Wali Liwa ■ Charity teams ■ OWA Liwa	■ Verbally during public disclosure meetings.	As indicated in the ESIA Section 8.6.5.4, a Social Investment Plan and Community Needs Assessment will be developed by MARSA LNG LLC in consultation with local communities, with active engagement required to determine the location and nature of investments. Relevant stakeholders will be kept informed on the progress of investment activities and opportunities. No changes were deemed necessary to the ESIA.
Stakeholder Engagement	Feedback from fishermen conveyed a sense of unfulfilled expectations and engagement fatigue. Grievances were expressed regarding the direct impacts of previous companies' operations within the SIPA, including issues such as noise from jetty hammering, cracks in the houses, and building damage. Requests were made to maintain the communities informed about the economic contributions of companies operating within the SIPA.	■ Fishermen ■ General public	■ Verbally during public disclosure meetings. ■ Written in feedback forms.	The Project will not result in additional restrictions to fishing or navigation and therefore no impacts on fishing livelihoods are expected. No changes were made to the ESIA. As indicated in the ESIA Section 8.6.5.4, quarterly project update leaflets will be prepared and widely distributed from six month prior to construction to the end of the construction phase. These information releases will emphasise the limited nature of employment and the recruitment processes and the inclusive nature and progress of the Social Investment Plan. No changes were deemed necessary to the ESIA.

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
Grievance mechanism	Participants commented on the online feedback form, stating it cannot be instantly filled online and suggested that the process should be simplified. They recommended making the form more user-friendly, possibly allowing for real-time online submissions, to encourage more responses from the local community.	■ Charity teams	■ Verbally during public disclosure meeting.	No changes made to the ESIA; this feedback will be considered going forward by MARSA LNG LLC.

Source: ERM, February 2024

7.5 Considerations for Future Stakeholder Engagement

The stakeholder engagement programme is designed to cover all phases of the Project. The general objectives of stakeholder engagement under this SEP are as outlined in Figure 7-4 below.

	Phase 0: Permitting and Preparation phase (ongoing)	**Phase 1: Site Preparation, Construction, Pre-commissioning and Commissioning** **Estimated duration:** **a) Construction activities:** 34 Months (starting Q3 2024 – concluding with the start-up of the plant in mid 2027) **b) Commissioning phase:** 15 Months (starting first quarter of 2026)	**Phase 2: Operations and Maintenance** **Estimated duration: 25 years**	**Phase 3: Decommissioning**
SEP Objectives	• Obtain licenses and permits (including ESIA approval) • Initiate actions to obtain the social license to operate the Project • Establish a Grievance Mechanism • Manage the recruitment process of local workforce	• Update stakeholders on Project progress • Address any grievances • Renew licenses and permits as required • Maintain the social license to operate the Project • Sustain peaceful working relationships with stakeholders	• Update stakeholders on Project progress • Address any grievances • Renew licenses and permits as required • Maintain the social license to operate the Project • Sustain peaceful working relationships with stakeholders • Manage the retrenchment process during transition from cons. to ops.	• Update stakeholders on decommissioning works and progress in schedule • Address Project decommissioning related grievances • Understand requirements from authorities • Manage the retrenchment process
SEP Activities	• Appointment of the CLO • Grievance procedure establishment • Disclosure of ESIA and Project activities to stakeholders • Engage around ESMP development	• Site presence of CLO and regular engagement Maintain grievance procedure • Maintain stakeholder register • Define and implement mutually agreed in-country value and social investment programs	• Site presence of CLO and regular engagement • Engagements related to transition from Phase 1 to Phase 2 • Maintain grievance procedure • Maintain stakeholder register Implement agreed social investment programs	• Site presence of CLO and regular engagement through engagement tools • Engagements related to retrenchment • Maintain grievance procedure • Maintain stakeholder register
Project Activities	• Project design and planning • Tendering • ESIA approval process • Permitting process	• Onshore facilities construction, jetty modifications, pipeline installation, transmission line and equipment and personnel mobilization.	• Operations of the LNG facilities, pipeline and transmission lines and associated facilities	• Hand over or Decommissioning of facilities • Reinstatement and restoration • Exit audits

Note: The social license to operate refers to the level of acceptance and (informal) approval by local stakeholders and communities where the Project operates. This does not consist in any formal permitting document.

Figure 7-4 Stakeholder Engagement Programme

Specific planning and engagement activities will be necessary at each Project phase. These are presented in Project's Stakeholder Engagement Plan – in Appendix B.
The activities that will be ongoing throughout the entire Project cycle and are therefore common to the different phases include the following:

- Regular update of the Non-Technical Summary (NTS) as the Project moves forward and activities, schedules and milestones evolve.
- Regular update and revision of the stakeholder register including stakeholder analysis and re-evaluation as necessary throughout the different Project phases.
- Addressing comments, questions, and grievances regularly and through appropriate channels, and issuing information to stakeholders. This includes regular refreshers to stakeholders about the Grievance Mechanism and related processes.
- Regular reporting to the different stakeholders as appropriate.
- Regular Project Monitoring reports.

7.6 Grievance Mechanism

The Community Grievance Mechanism enables any stakeholder to make a complaint or a suggestion about the way the Project is being implemented. Grievances may take the form of specific complaints for damages/injury, concerns about routine Project activities, or perceived incidents or impacts.

The purpose of the Community Grievance Mechanism Procedure is to implement a formalised process (identification, tracking and redress) to manage complaints/grievances from communities and other local stakeholders in a systematic and transparent manner that could potentially arise from the Project.

7.6.1 Grievance Procedure

The grievance procedure in Figure 7-5 is proposed to ensure an effective and timely response to community complaints and maintain good community and stakeholder relations. The six phases that constitute the grievance procedure are represented in Figure 7-5. These consist of:

- Phase 1: Receive
- Phase 2: Acknowledge
- Phase 3: Assess and Assign
- Phase 4: Investigate
- Phase 5: Propose
- Phase 6: Follow up and close out.

Source: MARSA LNG LLC, 2020

Figure 7-5 Grievance Mechanism Procedure

Further detail is provided in the Project's Stakeholder Engagement Plan (ERM, 2023).

7.7 Monitoring and Reporting Stakeholder Engagement Activities

It will be important to monitor and report on the on-going stakeholder engagement activities to ensure that the desired outcomes are being achieved, and to maintain a comprehensive record of engagement activities and the issues raised.

7.7.1 Data Management

In order to record activities, assess the effectiveness of the Stakeholder Engagement Plan and associated community dialogue activities, MARSA LNG LLC will implement a data management and monitoring process. Stakeholder engagement activities will be documented and filed in order to track and refer to records when required and ensure delivery of commitments made to stakeholders.

The following stakeholder community dialogue records and documentation will be used and maintained:

- Stakeholder list
- Stakeholder engagement log
- Commitments register
- Meeting minute template
- Grievance log

7.7.2 Internal and external reporting

The following internal reports will be developed:

- Red Flag Reports: consisting of weekly reports for urgent items (e.g. high potential grievances) or incidents of significant nature.

- Internal quarterly progress reports*:* these reports will summarise engagement activities undertaken in the reporting period, grievance mechanism, social license risk to the Project, limitations and priorities for the following quarter.

These reports will be discussed at quarterly meetings and will be circulated internally as required.

In addition, as an integral step in building relationships with stakeholders and promoting understanding between MARSA LNG LLC and its publics, it is recommended to keep track of commitments made (commitments tracker) with stakeholders and to communicate progress made against these commitments on a regular basis (for instance during regular meetings with the community representatives).

8 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The impacts section will describe the assessment methodology used to assess the potential Project impact on baseline conditions and will define the significance criteria used for this assessment. Potential cumulative impacts will also be assessed, by considering impacts arising from the Project and how these might interact with impacts from other existing or planned developments in the area.

8.1 Introduction

This Section presents the methodology for assessing potential environmental, social and health impacts that may result from both routine and non-routine (unplanned events) Project activities throughout its lifecycle (Project Construction, Pre-commissioning and Commissioning, Operations and Maintenance, Decommissioning as defined in Chapter 3 - Project Description.

For a complete and adequate impact assessment, the evaluation has taken into account International Best Practice guidelines such as the IFC EHS Guideline for Liquefied Natural Gas Facilities (2017) that serve to ensure that the main impacts associated with this type of projects are being taken into account and managed in the best manner.

Moreover, ERM has used its international experience in many similar types of projects to design and improve where necessary the proposed mitigation measures, while adapting them to the local context and TotalEnergies standards (i.e. both tailored to the local context, feasible to facilitate their implementation and carefully reviewing them with the Project team). Example of similar LNG studies that have been taken into account include: Kutubdia LNG Project in Cox's Bazar District of Bangladesh (2016 – 2018), LNG to Power Project in southern Myanmar (started in 2017), LNG Storage & Regasification Terminal in East Coast of India (started in 2017), LNG/Gas Infrastructure Development Project in Sri Lanka (started in 2018), CLP Power Hong Kong Offshore LNG Terminal Project (2016 – 2017), Phased gas field development with a Floating LNG in Ghana.

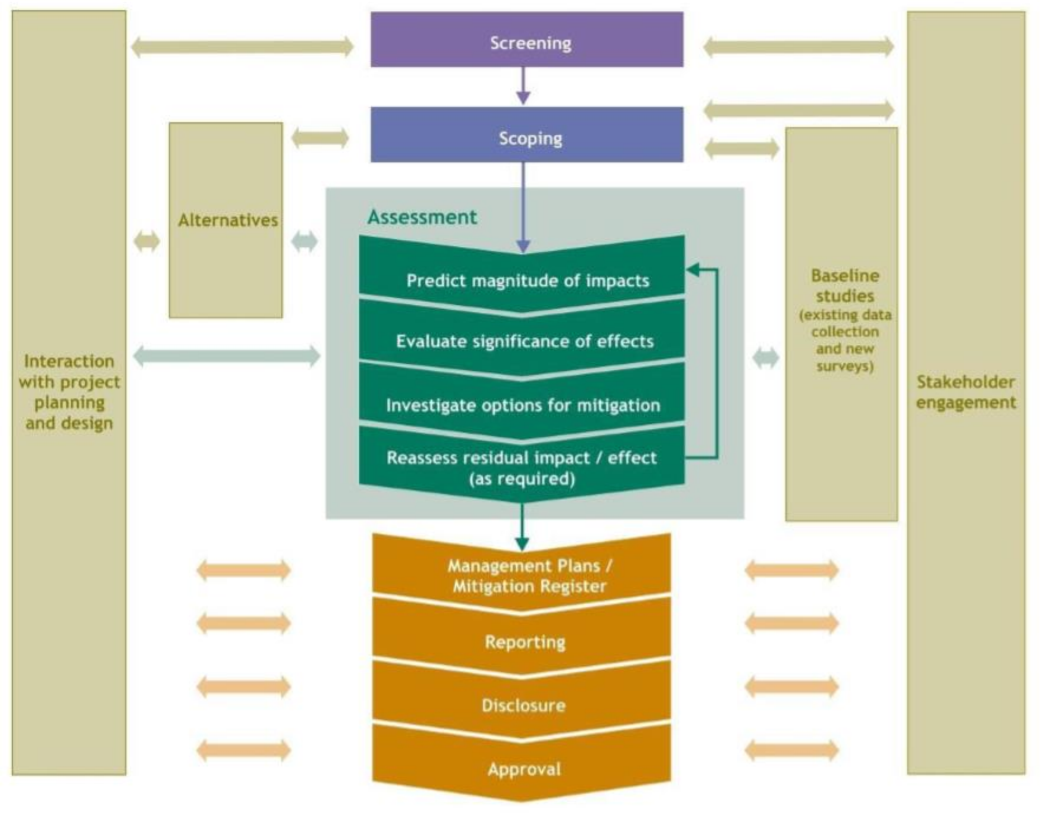
National regulations and international standards as presented in Section 2. Regulatory and Administrative Framework have also been considered in the impact assessment ensuring that these legal requirements, both national and international, are integrated in the proposed mitigation measures.

8.2 Impact Assessment Methodology

8.2.1 Introduction

The impact assessment process involves assessing the significance of impacts identified through the scoping process or that have subsequently come to light during baseline data collection. Impacts are assessed essentially through an objective exercise to determine what could happen to environmental and social receptors as a consequence of Project activities.

The overall approach followed is shown schematically in Figure 8-1 while the key steps taken are described in subsequent sections.



Source: ERM, 2012.

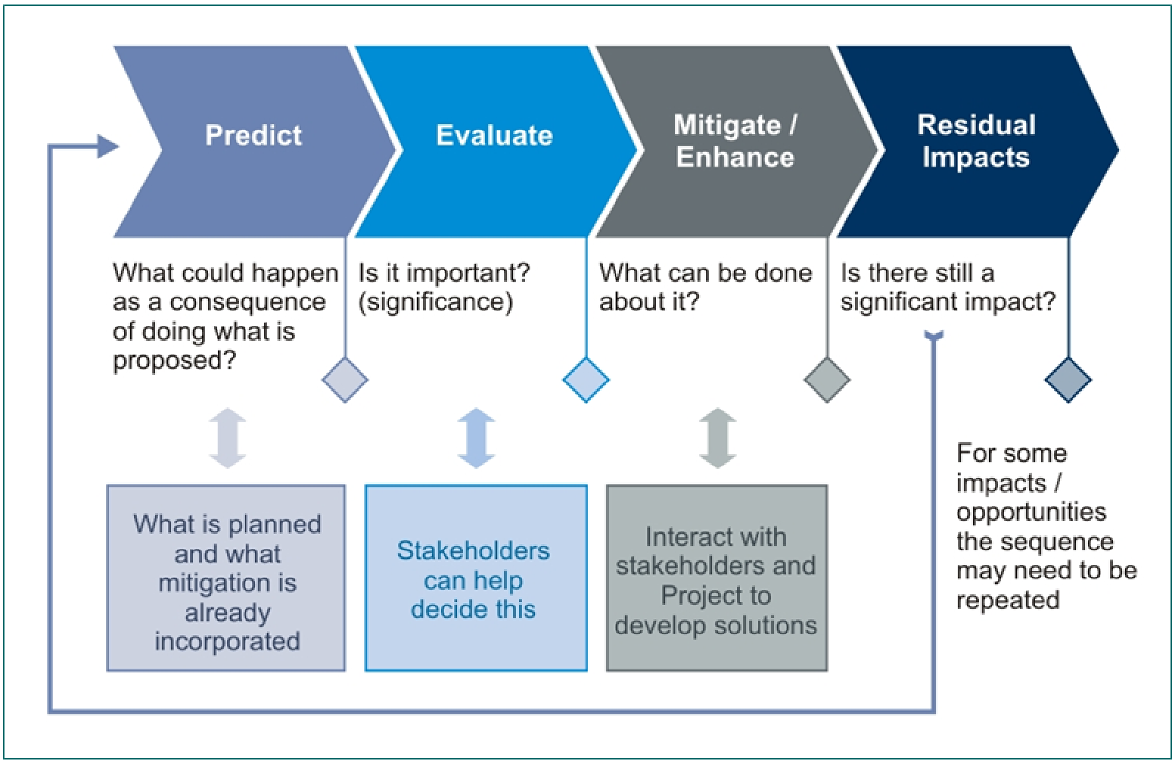
Figure 8-1 Impact Assessment Approach

An Impact Assessment update was conducted in July 2023 taking into account the findings of the 2023 desktop research update. The different sections of the Impact Assessment have been updated including the relevant information.

8.2.2 Description of the Impact Assessment Methodology

Impact identification and assessment starts with scoping and continues through the remainder of the impact assessment process. The principal impact assessment steps are summarised in Figure 8-2 and comprise:

- Prediction of Impacts: to determine what could potentially happen (both adverse and positive) to resources/receptors as a consequence of the Project and its associated activities.
- Evaluation of Impacts: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- Mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.



Source: ERM, 2012.

Figure 8-2 Impact Assessment Process

8.2.3 Prediction of Impacts

Prediction of impacts is an objective exercise to determine what could potentially happen (both adverse and positive) to the environment as a consequence of the Project activities. This is a repeat of the process undertaken in scoping, whereby the potential interactions between the Project and the baseline environment are identified. In the impact assessment stage, these potential interactions are updated based on additional Project and baseline information. From these potential interactions, the potential impacts to the various resources/receptors are identified and are elaborated to the extent possible. The diverse range of potential impacts considered in the impact assessment process typically results in a wide range of prediction methods being used including quantitative, semi-quantitative and qualitative techniques.

8.2.4 Evaluation of Impacts – Planned Events

8.2.4.1 Impact Characteristics

Once the prediction of impacts is complete, each impact is described in terms of its various relevant characteristics (e.g., type, scale, duration, frequency, extent). The terminology used to describe impact characteristics is shown in Table 8-1.

Table 8-1 Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	The relationship of the impact to the Project (in terms of cause and effect).	Direct Indirect Induced

Characteristic	Definition	Designations
Extent	The "reach" of the impact (e.g., confined to a small area around the Project footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is affected.	Temporary Short-term Long-term Permanent
Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	*[no fixed designations; intended to be a numerical value]*
Frequency	A measure of the constancy or periodicity of the impact.	*[no fixed designations; intended to be a numerical value]*

Source: ERM, 2012.

The definitions for the type designations are shown in Table 8-2. Definitions for the other designations are resource/receptor-specific and are discussed in the resource/receptor-specific chapters.

Table 8-2 Impact Type Definitions

Designations (Type)	Definition
Direct	Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., sound emitted from the survey leading to behavioural changes in marine fauna or land take by the project removing agricultural land upon which a household depends).
Indirect	Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., reduction in water quality from waste discharges leading to toxic effects in marine fauna).
Induced	Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

Source: ERM, 2012.

The above characteristics and definitions apply to planned and unplanned events. An additional characteristic that pertains only to unplanned events is likelihood. The likelihood of an unplanned event occurring is designated using a qualitative scale, as described in Table 8-3.

Table 8-3 Definitions for Likelihood Designations

Likelihood	Definition
Unlikely	The event is unlikely but may occur at some time during normal operating conditions.
Possible	The event is likely to occur at some time during normal operating conditions.
Likely	The event will occur during normal operating conditions (i.e., it is essentially inevitable).

Source: ERM, 2012.

8.2.4.2 Impact Magnitude and Receptor/Resource Sensitivity and Impact Significance

Once an impact's characteristics are defined, the next step in the impact assessment phase is to assign each impact a 'magnitude'. Magnitude is a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent
- Duration
- Scale
- Frequency

It should be noted that the extent characteristic is the preferred term as scale is mostly used when there are quantitative values available and for small scale projects where the size of the area potentially impacted can be quantified in an easy manner. For this Project, the scale will typically be the Project site/reclaimed area or will be the same as the extent characteristic as the numerical size of the impact will be too big to (i.e. at a regional and/or international level) to quantify. For this reason, when assessing each one of the impacts the Type, Duration, Frequency, Extent are characterised.

Additionally, for unplanned events only, magnitude incorporates the 'likelihood' factor discussed above.

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the impact. As discussed above, the magnitude designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor-by-resource/receptor basis (Table 8-4), as further discussed in each of the resource/receptor-specific chapters. The universal magnitude designations are:

- Positive
- Negligible
- Small
- Medium
- Large

Table 8-4 Impact Designation Definitions

Magnitude	Physical Receptors (e.g. air, water, sediments)	Biological receptors	Socioeconomical receptors
Negligible	Immeasurable, undetectable or within the range of normal natural variation.	Immeasurable, undetectable or within the range of normal natural variation.	Change remains within the range commonly experienced within the social-economic context.
Small	Minimal disturbance. Slight change in water quality expected over a limited area with water quality returning to background levels within a few meters. Discharges are well within benchmark effluent discharge limits.	Affects a specific group of localized individuals within a population[126] over a short time period (one generation or less), but does not affect other trophic levels or the population itself.	Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration.
Medium	Localized and/or short-term disturbance of seabed. Temporary or localized change in water quality with water quality returning to background levels thereafter. Occasional exceedance of benchmark effluent discharge limits.	Affects a portion of a population and may bring about a change in abundance and/ or distribution over one or more generations, but does not threaten the integrity of that population or any population dependent on it.	Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may be regional in scale
Large	Widespread and/or long-term disturbance or permanent change to the seabed. Change in water quality over a large area that lasts over the course of several months with quality likely to cause secondary impacts on marine ecology. Routine exceedance of benchmark effluent discharge limits.	Affects an entire population or species in sufficient magnitude to cause a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations.	Change dominates over baseline conditions. Affects the majority of the area or population in the Area of Influence and/or persists over many years. The impact may be experienced over a regional or national area.

Source: ERM, 2012.

In the case of a positive impact, no magnitude designation (aside from ‘positive’) is assigned. It is considered sufficient for the purpose of the IA to indicate that the Project is expected to result in a positive impact, without characterising the exact degree of positive change likely to occur.

[126] In discussing the importance of biological resources and receptors it is useful to attempt to describe how important the project area is to each population being assessed, especially for populations of fish, mammals and seabirds that hunt and range over a wide area. A particular species may be of high importance but the project area may be of low value to that species or make up a tiny percentage of its regional range.

In addition to characterising the magnitude of impact, the other principal impact evaluation step is definition of the sensitivity / vulnerability / importance of the impacted resource/receptor. There are a range of factors to be taken into account when defining the sensitivity / vulnerability / importance of the resource/receptor, which may be physical, biological, cultural or human. Other factors may also be considered when characterising sensitivity/vulnerability/importance, such as legal protection, government policy, stakeholder views and economic value.

As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis (Table 8-5). The universal sensitivity/vulnerability/importance designations are:

- Low
- Medium
- High

Table 8-5 Sensitivity Criteria for Environmental and Socioeconomic Receptors

Sensitivity	Physical Receptors (e.g., air, water, sediments)	Biological receptors	Socioeconomical receptors
Low	Existing airshed/water/seabed quality is good and the ecological resources that it supports are not sensitive to disturbance.	Ecological receptors are abundant, common or widely distributed and are generally adaptable to changing environments Species are not endangered or protected.	Minimal vulnerability: consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it.
Medium	Existing airshed/water/seabed quality shows some signs of stress and/ or supports ecological resources that could be sensitive to change in quality or physical disturbance (secondary ecological impacts are possible).	Some ecological receptors have low abundance, restricted ranges, are currently under pressure or are slow to adapt to changing environments. Species are valued locally / regionally and may be endemic, endangered or protected.	Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the Project and opportunities associated with it.
High	Airshed/water/seabed quality is already under stress and/ or the ecological resources it supports are very sensitive to change (secondary ecological impacts are likely).	Some ecological receptors in the area are rare or endemic, under significant pressure and / or highly sensitive to changing environments. Species are valued nationally /globally and are listed as endangered or protected.	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project and opportunities associated with it.

Source: ERM, 2012

8.2.4.3 Impact Significance

Once magnitude of impact and sensitivity/vulnerability/importance of resource/receptor have been characterised, the significance can be assigned for each impact. Impact significance is designated using the matrix shown in Table 8-6.

Table 8-6 Impact Significance

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

Source: ERM, 2012.

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix. Table 8-7 provides a context for what the various impact significance ratings signify.

It is important to note that impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the Project design, regardless of the results of the impact assessment process). An example of an embedded control is a standard acoustic enclosure that is designed to be installed around a piece of major equipment. This avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the Project that considers none of the embedded controls.

To assess the significance of the impacts, they must be reflected in the local environmental frame of reference. For instance, communities with strong cultural norms may be more disrupted by the influx of a non-local workforce than people living in a cosmopolitan place. In this way, stakeholders' views on impacts are explicitly incorporated into the assessment, for example by making reference to development policies and plans and/or by reporting the results of stakeholder consultations, including quotes from consultations, etc. Thus, the importance of socio-economic impact is assessed in terms of the importance that stakeholders attach to that impact.

Table 8-7 Context of Impact Significances

An impact of **negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.

An impact of **minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.

An impact of **moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of

moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently. An impact of **major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

Source: ERM, 2012.

8.2.5 Evaluation of Impacts – Unplanned Events

For accidental events, the methodology is slightly different, as the events may or may not occur, risk assessment methodology is normally used. This risk assessment method includes the concept of likelihood or frequency of event, which is then combined with the consequence of the event, its severity. That severity of the consequence is assessed in the same way as the routine events, combining the magnitude of the impact and the sensitivity of the receiving environment.

As mentioned, both variables are looked at in combination to evaluate whether an impact due to an accidental event is significant. Significance depends on the level of acceptability of the risk. Risk magnitudes, when possible, can be quantified (as with Quantitative Risk Assessments used traditionally for assessing industrial risks with potential effects on human health and safety). If not possible, different legal or social events are usually assessed to determine risk acceptability levels.

The general degree of impact significance for accidental events is usually assessed with qualitative matrices, as the MARSA LNG LLC Risk Matrix (refer to Table 8-8), which is used in evaluating the severity and likelihood of accidental events occurring from the Project. The philosophy of these matrices is that frequency/likelihood of events and their consequences are inversely related. The most frequent and likely events usually have small consequences (for examples small leaks) whereas inversely events with potential catastrophic consequences are very rare or improbable. There are three main areas of significance in this matrix, which is similar to all other matrices used for this purpose.

- The green area are the normally acceptable risks, which combine events with different degree of probability, but low severity. The typical examples of those are small leaks and spills, which in fact even as conceptually accidental, they are so frequent that are classically assessed as routine impacts.
- On the contrary, the red zone are the unacceptable risks, which relate to very rare/infrequent events with catastrophic consequences. The problem of these risks is that if they have happened at least once or could potentially happen (case of massive spills in the ocean or industrial accidents with casualties) they are intrinsically unacceptable, but in practice some of them permitted if they can be moved to the yellow area, applying feasible and practical mitigation measures, either or both lowering the probability of occurrence of the event and/or their consequences.
- In practice, most of the relevant identified risks will fall on the yellow area, risks which have a medium probability and severity. These risks need to be demonstrated to be reduced to a concept As Low As Reasonably Practicable (ALARP), There is no universally accepted definition of ALARP and it is assessed on a case by case basis.

Table 8-8 MARSA LNG LLC's Risk Assessment Matrix

		Severity of Consequence					
		Minor	Moderate	Serious	Very Serious	Catastrophic	Disastrous
		1	2	3	4	5	6
Likelihood of Occurrence	6	6	12	18	24	30	36
	5	5	10	15	20	25	30
	4	4	8	12	16	20	24
	3	3	6	9	12	15	18
	2	2	4	6	8	10	12
	1	1	2	3	4	5	6

The severity and likelihood rating descriptions are provided in Table 8-9 and Table 8-10 below.

Table 8-9 Severity of Consequence Descriptions

Severity Rating	Description
1 – Minor	Minor spill – no environmental impact
2 – Moderate	Minor pollution with a very limited environmental impact
3 – Serious	Moderate pollution with limited environmental consequences
4 – Very Serious	Pollution having significant environmental consequences
5 – Catastrophic	Large-scale pollution of ecosystems having recognized ecological value
6 – Disastrous	Pollution having massive and durable consequences for vast ecosystems having a high ecological value

Table 8-10 Likelihood of Occurrence Descriptions

Likelihood	Description
1 – Remote	Event physically possible but has never or seldom occurred over a period of 20 to 30 years for a large number of sites (> few thousands)
2 – Extremely Unlikely	Has already occurred in the industry but corrective action has been taken
3 – Very Unlikely	One time per year for at least 1000 units. One time for every 100 to 200 similar plants in the world over 20 to 30 years of plant lifetime. Has already occurred in the company but corrective action has been taken.
4 – Unlikely	Could occur once for every 10 to 20 similar plants over 20 to 30 years of plant lifetime
5 – Likely	Could occur several times during plant lifetime
6 – Very Likely	Expected to occur several times during plant lifetime

8.2.6 Identification of Mitigation and Enhancement Measures

Once the significance of an impact has been characterised, the next step is to evaluate what mitigation and enhancement measures are warranted. For the purposes of this impact assessment, ERM has adopted the following mitigation hierarchy:

- Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project (e.g., avoiding by siting activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
- Minimise on Site: add something to the design to minimize the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping).
- Minimise at Receptor: if an impact cannot be minimized on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby receptors or fencing to prevent animals straying onto the site).
- Repair or Remedy: some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures.
- Offset / Compensate in Kind / Compensate Through Other Means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

The priority in mitigation is to first apply mitigation measures to the source of the impact (i.e., to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (i.e., to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

8.2.7 Residual Impact Evaluation

Once mitigation and enhancement measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation and enhancement measures.

8.2.8 Management and Monitoring

The final stage in the impact assessment process is definition of the management and monitoring measures that are needed to identify whether: a) impacts or their associated Project components remain in conformance with applicable standards; and b) mitigation measures are effectively addressing impacts, and compensatory measures and offsets are reducing effects to the extent predicted.

An Environmental and Social Management Plan, which is a summary of all actions which the consortium has committed to executing with respect to environmental/social/health performance for the Project, is also included as part of the EIA report. The Environmental and Social Management Plan includes mitigation measures, compensatory measures and offsets and management and monitoring activities.

8.2.9 Cumulative Impact Assessment (CIA) Methodology

IFC Performance Standard 1 provides a definition for cumulative impacts, as impacts that:

> "result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted."

Cumulative impacts are those that act together with other impacts, from the same or other projects, to affect the same environmental or social resource or receptor. Project impacts will combine with impacts from established and future industrial activities to form into cumulative impacts. The Project is surrounded by zones of light and heavy industry (>35 industrial companies) relating to logistics, petrochemicals, metals, automotive and food production which in turn support localised operations relating to iron, steel, plastics, rubber, ceramics, and chemicals (SIPC, 2019).

Key cumulative impacts are likely to include impacts on the physical, biological, and social environment with regard to air quality, water discharge, and community health, safety and security (HSS), respectively.

Transboundary impacts are those that extend or occur across a national boundary (impacts that affect countries other than the country in which the project will be constructed or operated).

Cumulative impacts are generally considered to be impacts that act with impacts from other projects such that:

- The sum of the impacts is greater than the parts; or
- The sum of the impacts reaches a threshold level such that the impact becomes significant.

The types of cumulative impacts that may be relevant are the following:

- Accumulative: the overall effect of different types of impacts from the LNG project at the same location. An example would be fugitive dust emissions, construction noise and construction traffic all impacting the nearby local communities as a nuisance/ disturbance.
- Interactive: where two different types of impacts (which may not singly be important) react with each other to create a new impact (that might be important). An example would be water abstraction from a watercourse, which might exacerbate the impacts caused by increased sediment loading.
- Additive or In-combination: where impacts from the primary activity (i.e. the construction and operation of the LNG Project) are added to impacts from third party activities e.g. other major projects in the vicinity of the Project which are already occurring, planned or may happen in the foreseeable future. In this case, we would refer to impacts from other heavy industries located at the Sohar Port Area. Such impacts may arise due to spatial overlap (e.g. overlap in spatial extent of water quality changes) or temporal overlap (e.g. sound impacts caused by construction activities at the same time from different sources).

Overall there are many challenges associated with conducting a Cumulative Impact Assessment (CIA) process including lack of basic baseline data, uncertainty associated with anticipated developments, limited government capacity, and absence of strategic regional, sectoral, or integrated resource planning schemes. As feasible, Cumulative Impacts will be assessed following the guidance of the IFC document Good Practice Handbook (GPH) on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, published in 2013.

What the guideline recommends, and it is adopted in this ESIA, is a useful preliminary approach for developers in emerging markets to conduct a rapid cumulative impact assessment (RCIA). The RCIA can be an integral component of the ESIA or a separate process: in this specific case it has been included as a component of the ESIA study. RCIA entails a desk review enables the developer to determine whether its activities are likely to significantly affect the viability or sustainability of selected Valued Environmental and social Components (VECs).

Depending on the scenario, the RCIA may evolve into a more robust and comprehensive CIA, which requires the participation of many parties and is best led by local governments or regional planners.

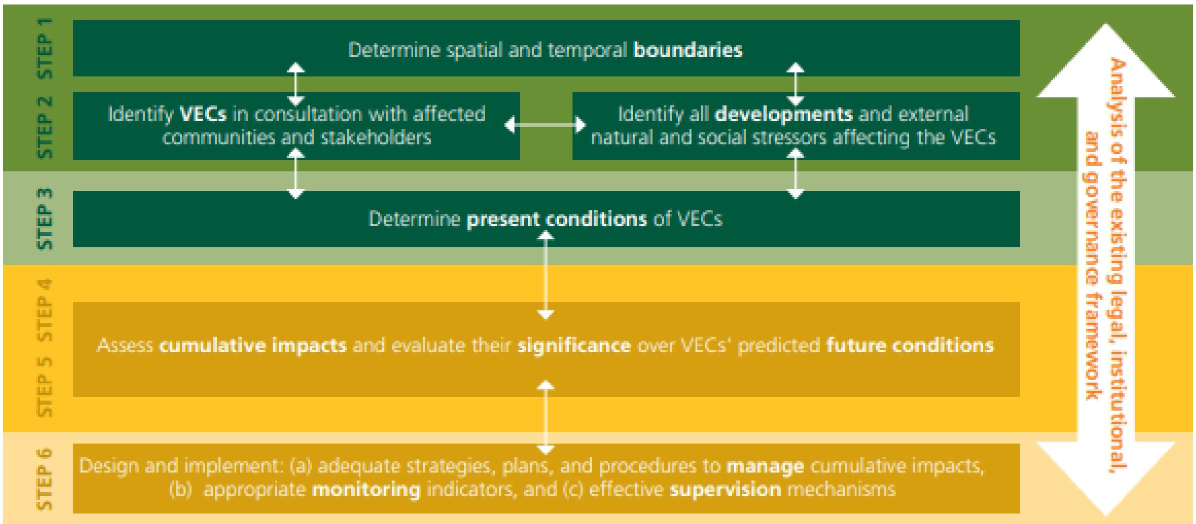
The overarching objectives of the identification and assessment of cumulative impacts are the following:

(a) recognition by each party that their actions, activities, and projects may contribute to cumulative impacts on Valued Environmental and social Components (VECs) on which other existing or future developments may also have detrimental effects; and
(b) avoid and/or minimise these impacts to the greatest extent possible. Furthermore, their developments may be at risk because of an increase in cumulative effects over ecosystem services they may depend on.

In order to accomplish these objectives, the CIA logical framework includes a six-step process (as shown in the following Figure 8-3):

- Scoping (Steps 1 and 2),
- VEC baseline determination (Step 3),
- assessment of the contribution of the development under evaluation to the predicted cumulative impacts (Step 4),
- evaluation of the significance of predicted cumulative impacts to the viability or sustainability of the affected VECs (Step 5), and
- design and implementation of mitigation measures to manage the development’s contribution to the cumulative impacts and risks (Step 6).

In Section 8.10 – Cumulative Impacts, it is describing how this six-step approach has been implemented in this ESIA, including the objectives of each step and how they have been accomplished in the assessment.

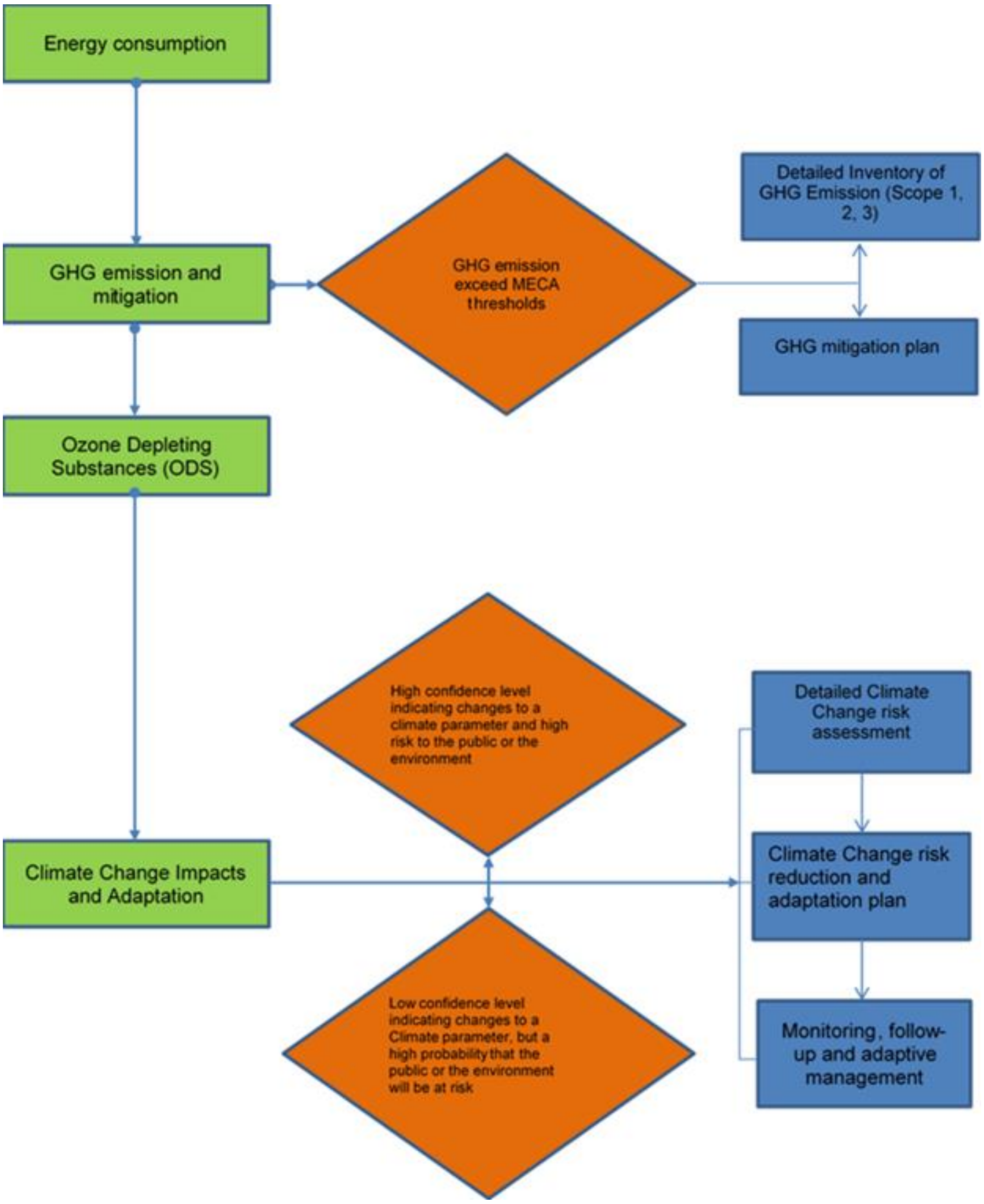


Source: IFC, 2013

Figure 8-3 Rapid CIA – Six-step process

8.2.10 Climate Affairs methodology

The MD 20/2016 and MECA (now EA) Guideline: Form 1 (2017)[127] require that project aspects and impacts related to climate change are assessed as part of an EIA (Figure 8-4) for typically all industrial and infrastructural developments. The extent of the assessment is dependent on MECA climate change thresholds, whereby projects that exceed the thresholds require additional assessment.



Source: EA Guideline: Form 1, 2017

Figure 8-4 ESIA climate change scope

127 Ministry of Environment and Climate Affairs - Form 1 – Guidelines on the preparation of Climate Chapters in EIA (2017).

EA climate change thresholds

National climate change thresholds for the energy and industrial sector are:

- Production of 2,000 or more metric tons of CO_2 per year; and
- Production or consumption of 30 TJ/year.

Climate change license

While typically included in an overall environmental approval issued by EA, a Project proponent may need to apply for a separate climate change licence (if EA climate change thresholds are exceeded). In terms of the energy and industrial sector, a climate change license (and fee) is applicable for the following CO_2 equivalent emission categories:

- 2,000- 500,000 tons of CO_2 equivalent per year (Fee: OMR 200);
- 500,000- 100,000 CO_2 equivalent per year (Fee: OMR 500); and
- >1 million tons of CO_2 equivalent per year (Fee: OMR 1000).

The license fees for all other sectors (exceeding their respective thresholds) is OMR 100.

8.2.10.1 Climate change reporting

The EIA assessment should include a description of energy sources and consumption, GHG emission and mitigation, Ozone Depleting Substances (ODS), and climate change impacts and adaption. If relevant information is not available prior to EIA submission, it can be highlighted as a gap in the EIA and provided during the operational phase of the Project (if approved by EA).

Energy Sources and Consumption

This section should provide information about:

- Energy sources (i.e. Liquid fossil fuel, Gaseous fuel, Solid fuel and Electricity) and energy consumption during all stages of the Project (e.g. construction, testing, and operation)
- Annual energy consumption during the operational phase of the project; and
- Energy technology analysis outlining energy consumption for the main Project facilities.

Greenhouse Gas Emission and Mitigation

In keeping with MD 20/2016 (Annex A), GHG in Oman relates to:

- Carbon Dioxide (CO);
- Methane (CH_4);
- Nitrous Oxide (N_2O);
- Hydrofluorocarbon Compounds (HFCs);
- Perfluorocarbons (PFCs); and
- Sulphur Hexafluoride (SF_6).

For projects below EA climate change thresholds

A preliminary assessment must seek to identify:

- Relevant GHG emissions associated with the Project[128]

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[128] Greenhouse gases from stationary and mobile sources resulting from fuel combustion processes, industrial operations, chemical interactions, leak and other operations (MD 20/2016).

- Project components that are likely to exceed EA climate change thresholds during any phase of the Table 8-11); and
- Feasible policies and measures that aim to reduce greenhouse gases including the improvement of energy production and consumption, increasing the use of low carbon technologies and renewable energy, reusing carbon in industries, and increasing carbon sinks.

Mitigation should outline policies and measures that aim to reduce greenhouse gases including the improvement of energy production and consumption, increasing the use of low carbon technologies and renewable energy, reusing carbon in industries, and increasing carbon sinks.

For projects above EA climate change thresholds

In the event that predicted emissions exceed EA climate change thresholds, a detailed assessment is required in terms of emission Scopes 1-3 (Table 8-11) in conjunction with a mitigation plan (i.e. annual GHG emission reduction in Tons CO_2e, green cover in m^2, as well as feasible reduction targets in Tons CO_2e, incorporating economic analysis and timelines).

Table 8-11 Description of different scope emissions (MD 20/2016).

Scope	Description	Relevance to the Project
Scope 1 Emissions	Relates to direct GHG emissions from sources owned or controlled by the establishment, occur within the physical boundaries of the project concerned, and generated from: stationary combustion, Combustion from transportations, Industrial processes, Fugitive emissions.	■ **Construction/Pre-commissioning:** Relevant to mobile vehicles and heavy machinery used on project site. ■ **Operation:** Relevant to flaring emissions generated by the project during start-up, emergency conditions, and plant shut-down, and mobile vehicle emissions.
Scope 2 Emissions	Relates to indirect GHG emissions from activities occurring within the physical boundaries of the establishment yet generated from sources or facilities owned or controlled by another establishment which includes: Purchased: electricity, cooling and heat, as well as steam	■ **Construction/Pre-commissioning:** Relevant to electricity purchased from the municipal grid. ■ **Operation:** Relevant to electricity purchased from municipal grid.
Scope 3 Emissions	Relates to indirect GHG emissions outside of Scope 2 related to: Solid waste, wastewater, and other sources linked with logistics and purchasing of materials in conjunction with emissions of associated facilities and parties.	■ **Construction:** Relevant to solid waste, wastewater generated by the project; including emissions generated by third parties from material purchases and logistics (i.e. sub-contractors) ■ **Operation:** Same as construction

In terms of mitigation, Article 13 of MD 20/2017 requires the Climate Change Licensee (i.e. proponent) to:

- Use high-efficient, less energy consuming and low GHG emissions technologies during the design and operation of project or establishment. These practices and technologies shall be included in the periodic reports provided to the Directorate.
- Provide to the Directorate a plan for greening of project's or establishment's area in a way that ensures the appropriate selection of trees and plants suitable to the local environment conditions and that help to increase absorption areas of greenhouse gases from the atmosphere.
- Use renewable energy sources according to their technical and financial feasibility, and use projects of clean development mechanism and similar mechanisms under the convention and the protocol.

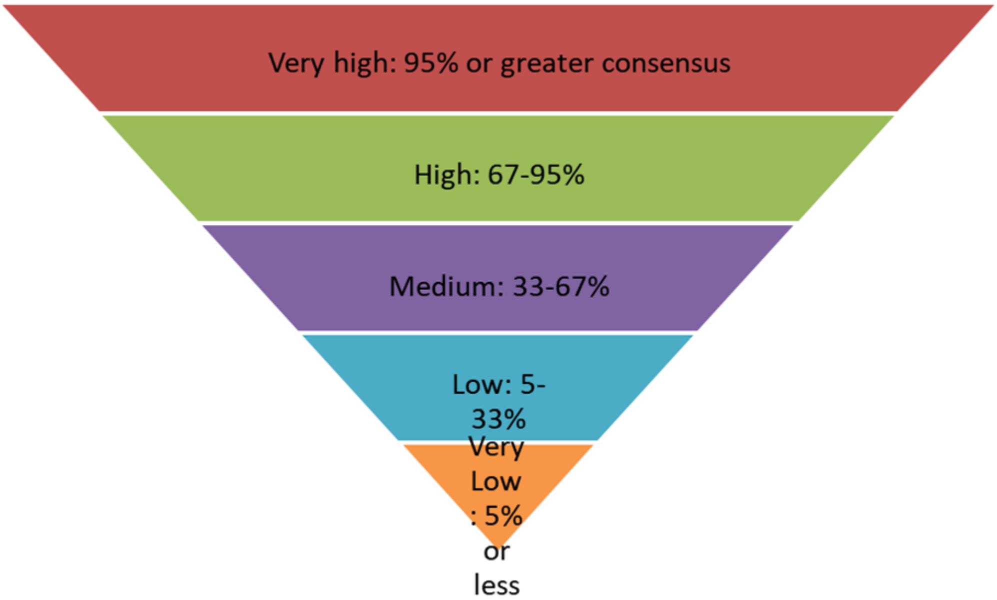
- Use appropriate technical options to reduce power consumption when designing buildings that consume more than 2.500 megawatt / hour of electricity per year.

Ozone Depleting Substances

An inventory of Project equipment, machinery, and appliances should be made using with reference to Ozone Depleting Substances (ODS). If the Project requires ODS, a plan to phase ODS out of the Project needs to be described.

Climate Change Impacts and Adaptation

The level of confidence and probability of project climate change risks to the public needs to be assessed using Table 8-12 and Figure 8-5. If the Project is unlikely to have a high risk of impact to the public or environment (i.e. case 2 or 4 in Table 8-12); further assessment is not required.



Source: EA Guideline: Form 1, 2017

Figure 8-5 Confidence levels for Ranking Project Sensitivities to Climate Change

Table 8-12 Possible Cases Determined from Risks to the Public or Environment from Climate Change Impacts on a Project

Confidence	High Risk of Impacts to the Public or the Environment	Low Risk of Impacts to the public or environment
High confidence level of the project's sensitivity to a climate change parameter	Case One: ■ Proceed with detailed climate change risk assessment. ■ Implement appropriate monitoring, follow up, and adaptive management measures.	Case Two: ■ General Information to be provided. ■ No further action required.
Low Confidence level of the project's sensitivity to a climate change parameter	Case Three: ■ Proceed with detailed climate change risk assessment. ■ Emphasize the uncertainty inherent in climate change data. ■ Implement appropriate monitoring, follow up, and adaptive management measures.	Case Four: ■ No further action required.

Source: MECA Guideline: Form 1, 2017

If the Project is likely to have a high risk of impact to the public or environment (i.e. case 1 or 3 in Table 8-12); the following is required to be included in the EIA:

- Climate change reduction & adaption plan; and
- Climate change monitoring and adaptive management.

Climate change reduction & adaption plan

An adaptation plan should be provided to define:

- Adaptation measures to reduce project vulnerability to climate change risk;
- Adaptive management plan to reduce risks associated with climate change; and
- Public and private sector risks and responsibilities.

In terms of mitigation, Article 14 of MD 20/2017 requires the Climate Change Licensee (i.e. proponent) to:

- Take into account the predictable negative effects of climate change on the Project site or establishment or area of work, and take all necessary adaptation measures and precautions to protect equipment, technologies, raw materials, and others from those effects;
- Take appropriate measures to reduce the impact of rising temperatures on the Project, establishment and workers, and apply water use efficiency requirements during drought and water scarcity periods; and
- Include the appropriate adaptation measures in the climate affairs chapter with an update every five years.

Climate change monitoring and adaptive management

Monitoring, follow-up, and adaptive management should be carried out to assess the performance of the climate change reduction & adaption plan measures over the lifetime of the project; within the context of relevant climate change projections.

8.2.11 Climate Change Risk Assessment

In alignment with the guidance set out by the Equator Principles 4 (EP4) (published in July 2020) and the accompanying 'Guidance Note on Climate Change Risk Assessments' (published in May 2023, and collectively referred to as the 'CCRA guidance'), a Climate Change Risk Assessment needs to be carried out depending on the project's potential to cause adverse environmental and social risks and/or impacts. In order to determine whether an EP4-aligned CCRA should be completed for a project, EP4 guidance recommends that a client assigns its project a categorization, in accordance with the International Finance Corporations (IFC) definitions (see figure below for these definitions):

Category A

- *Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;*

Category B

- *Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and*

Category C

- *Projects with minimal or no adverse environmental and social risks and/or impacts.*

Figure 8-6 Project categories as defined by the IFC

Based on these definitions, the Project falls under Category A. For Category A and, as appropriate, Category B projects, a CCRA should include consideration of relevant climate-related ‘Physical Risks’ as defined by the Task Force on Climate-Related Financial Disclosure (TCFD).

In addition, when combined Scope 1 and Scope 2 emissions are expected to exceed 100,000 tonnes of CO_2 equivalent annually, all projects, in all locations, must include the consideration of climate-related ‘Transition Risks’ (as defined by the TCFD) in a CCRA.

Similarly, if this threshold is exceeded a greenhouse gas (GHG) alternatives analysis is also required (according to EP4 CCRA guidance).

The details of the Project’s CCRA scope and methodology are explained in Appendix D of this ESIA.

8.3 Impact Identification Matrix

The impact identification matrix presented in Table 8-13 assesses interaction of Project activities with physical, biological, and social aspects to identify potential impacts. Each marked cell on the impact matrix represents a potential interaction between a project activity and an environmental or social and health receptor or resource (i.e., potential impact).

Blank cells in the matrix indicate no primary effect or an absence of the resources in the general area. These interactions have not been included in the detailed impact assessment, as their impact is considered non-existent or negligible (i.e., they are not expected to lead to a significant impact).

Table 8-13 Impact Identification Matrix

	PHYSICAL RECEPTORS								BIOLOGICAL RECEPTORS			SOCIOECONOMIC RECEPTORS				
	Air Quality	Climate Change	Soil	Noise	Surface water	Ground water	Seawater / Sediment Quality	Landscape & Visual	Terrestrial Ecology & Habitats	Marine Ecology & Habitats	Sensitive species	Local Economy & Employment	Maritime navigation and sea users	Infrastructure, Transport & Utilities	Community HSS	Ecosystem Services
Routine Project Activities																
Construction																
Land take and Foundation construction	x		x	x				x	~~x~~		X	x		x	x	x
Erection of equipment and buildings			x	x				x				x		x	x	
Access road construction/ upgrade	x		x	x				x	X			x		x	x	
Pipelines construction and installation	x		x	x	x			x	x					x	x	
Generation of hazardous/non-hazardous waste	x	x	x		X	x		x	x	x	x	x		x	x	x
Water consumption												x		x		x
Operation of temporary labour camps	x	x	x	x	x	x		x	x			x		x	x	
Construction laydown and chemical/fuel storage	x	x	x		X	x	X	x	x		X	x			x	
Offshore and onshore transportation and traffic	x	x	x	x	x		x			X	X	x		x	x	
Hydrostatic testing					X		x								x	
Labour contracting / Physical presence of workers									x			x		x	x	
Retrenchment of workforce												x		x	x	
Use of national / international supply chain		x										x		x		x
Operations																
Operation of jetty and pipelines	x	x				x	x	x	x	X	X				x	x
Generation of hazardous / non-hazardous waste	x	x	x		X	x		x	x		X	x		x	x	x
Generation of waste water / storm water runoff					X	x	x	x		x		x		x	x	x
Electricity consumption	x	x		x								x		x		
Water consumption												x		x	x	
Fuel and chemical consumption	x	x										x			x	x
Marine vessel traffic	x	x					x	x		X	x		x	x	x	
Operation of combustion equipment (incinerator, flare, generator)	x	x		x				x	x			x			x	x
Operation of LNG train, compressors and pumps	x	x	x	x		x			x	X		x		x	x	
Transport / physical presence of workers	x	x		x				x				x		x	x	x
Labour Contracting												x		x	x	
Retrenchment of workforce								x				x		x	x	x
Economic stimulation												x		x		x
Use of national supply chain		x												x		
Decommissioning																
Removal, recycling/disposal of surface structures			x	x	x			x				x	x	x	x	
Movement of vehicles, equipment, personnel	x	x		x	x			x	x			x		x	x	
Storage and handling of fuels and chemicals	x		x		x	x	x		x	x	x			x	x	x
Treatment and disposal of wastes	x	x	x		x	x	x		x	x				x	x	x
Reinstatement and restoration of the affected sites			P		P			P	P			P		P	P	P
Accidental and non-routine Events																
Flaring / Use of Emergency generator	X	X		x				x	x		x			x	x	x
Uncontrolled loss of containment at the plant	X	X		x				x	x		x			x	x	x
Occurrence of moderate/major leaks and spills	x	x	x		x	x	x	x	x	x	x		X	x	x	x

Note: Blank cells – An interaction is not reasonably expected (white) / Cells marked with x – An interaction is reasonably expected / Cells marked with P – A positive interaction is expected.

8.4 Aspects Scoped Out of the ESIA

Although potential interactions between project activities and the receiving environment are expected, Table 8-14 presents the impacts have been scoped out from the ESIA and provides a justification.

Table 8-14 Aspects scoped out of the ESIA.

Aspect	Assumption / explanation
Impact assessment of the activities associated to the reclamation project	The impact assessment related to the soil extraction, transport and construction of project site and associated jetty is responsibility of SIPC, and has been covered through the Reclamation Land ESIA.
Other existing facilities within the Port	Other port facilities are managed by SIPC and will not be affected by the Project.
Archaeology of Project site	Project site is built on reclaimed land sourced from dredging material, and impacts associated to archaeological remains encountered during its excavation and transport to the site will be covered by Reclamation Land ESIA.
Marine waste water effluent modelling	No effluents will not be disposed of to the marine environment as part of the project design, and modelling is thus not necessary. The only considered impact to the marine water and sediment quality will arise from storm water and discharges from vessels, and potentially from discharges of hydrotest water during construction (either disposed of by an authorized company or discharged to the sea.
Potential increased cost of living to locals due to higher demand for goods and services	The total population of Sohar and Liwa was 237,632 for Sohar and approximately 25,000 for Liwa. From these figures, 48.81% and 32.74% are expatriates in Sohar and Liwa respectively. Considering the project will employ 1,800 at peak construction times, the increase is not considerable for impacting cost of living to locals.
Increase pressure on water resources for local communities	Water for the LNG Plant construction and operation phases will be sourced directly from the Majis Industrial Services Company (MISC) which provides industrial and potable water to both other Port tenants and local communities which are sourced through the Sohar Power and Desalination Plant that distributes potable water to local communities. Considering the project water needs during construction (highest consumption associated to the hydrotesting activities, 96,000 m3 (of sea water and fresh water) a month over a period of 30 months) and during operation (approximately 240 m3/d of processed water a day over a 25 year period), it is assumed the MISC has the capacity to source this water without causing disruption to its operations and impact availability of water to communities (the Sohar Power and Desalination Plant has a capacity to desalinise 37,000 m3 of water daily). It should be noted that sea water intake systems such as the MISC seawater intake, are prone to macro-fouling by marine organisms that occur in the natural environment and this susceptibility would be exacerbated by fast growing, invasive species. However, the Project is considered unlikely to lead to rapid growth of invasive species causing disruption to sea water intake systems. The cumulative impact of the invasive species risk has been assessed in Section 8.10.
Land Acquisition and terrestrial livelihoods	The Project does not imply any land take, land acquisition nor any sort of land use of the neighbouring areas as all project activities will be carried out in the already existent Port area and in the SIPC Concession area. Thus, terrestrial livelihoods, such as date farming or herding activities will not be affected by the project.
Fisheries and fishing livelihoods	The construction of the Sohar Port in the early 2000s in the Wilaya of Liwa resulted in the loss of fishing grounds corresponding to the Port's concession area and restriction area (3 km into the sea and 7 km wide), as well as fishing grounds along the beach in the nearshore area where the Port was built (See Figure 8.5). The LNG Plant will not result in additional restrictions to fishing or navigation and therefore no impacts on fishing livelihoods are expected.
Intensive use on waste management facilities	During construction, wastewater will be collected into a septic tank for later disposal by an authorized company. Hydrotest water will be reused in the hydrotesting of different part of the project and then disposed of by an authorized company operating in Sohar Port or discharged to the sea. If hydrotest water disposal into the sea is the selected method chosen, it will fully meet Omani environmental standards and

Aspect	Assumption / explanation
	legislation. During operations, wastewater treatment will be ensured by an external party operating in Sohar Port. Wastewater (clean process and drain water) will be gathered at the plant to be exported to the external treatment unit. The waste facilities operators are assumed to have sufficient capacity to treat waste without causing disruption to local communities
Intensive use of electricity	The power will be provided from the existing grid supplied by power plants located at the Sohar Port. The LNG Plant will be connected to the network via an underground cable. It is assumed the Sohar Port has the capacity to source electricity without causing disruption to its operations

It must be noted that while the vessel traffic for users is not part of the MARSA LNG LLC LNG Bunkering Project scope, it is considered as an associated activity for the scope for the ESHIA, therefore, the activities associated to marine traffic, vessel movements and operations inside the port area are part of the scope of this ESIA.

In addition, the feed gas to be delivered and processed at the LNG Plant will be supplied through the OQGN network, which is Oman's exclusive gas transportation system operator, and is not part of the MARSA LNG LLC's LNG Bunkering Project scope. Through MARSA LNG LLC's 33.2% equity on Block 10, MARSA LNG LLC will have the right to take 150 MMcf/d from the domestic network to supply the LNG Plant. The gas that will be treated at the LNG plant will not directly come from Block 10, as different gas field feed the national gas transportation system between the Block 10 location and the Sohar port.

Furthermore, the solar plant, considered to be an associated facility of the Project is planned to be built in a different plot outside the port as a source of renewable energy for the Project, that will reduce the overall GHG, and more specifically GHG Scope 2, emissions of the main plant. The solar plant will be the subject of a separate ESIA, but its contribution to the cumulative impact of the Project is assessed in Section 8.10.2.2.

This section identifies and assesses the environmental and socioeconomic impacts and risks of the Project as well as detailing of any proposed mitigation measures. The assessment has been undertaken as per the method presented in Section 8.2.

The residual impacts and risks are assessed taking into account the implementation of the mitigation measures. These are either embedded in the Project Design or are additionally identified as a result of the assessment. The latter measures will need to be detailed and implemented in the final Project design and/or Environmental and Social procedures and plans.

Potentially relevant sources of impacts and risks have been screened and identified in the previous sections of this ESIA, in particular Section 3, 4, 5 and 6. These sections have established:

- the technical, spatial and temporal scope assessed in the ESIA;
- the relevant interactions between Project activities and the receiving environments (physical, biological, and social); and
- the impact identification matrix of anticipated regular, cumulative, and unplanned impacts associated with the Project.
- The temporal scope of the ESIA covers the three main phases of the Project:
- Construction and Commissioning
- Operation and Maintenance
- Decommissioning

The duration of the activities within each of these three phases is described in Section 3 – Project Description and each has its own environmental and socioeconomic impacts, and risk potential.

As previously established, impacts in the following sections are described and assessed according to the receptor they affect (see Section 4, 5 and 6 – Baseline Description for details on the potential receptors, their importance, and values and sensitivities towards Project activities).

The Project site is described in Section 3.2.1. The ESIA study boundaries is comprised of a "Direct Area of Influence" over which routine activities of the Project will take place (e.g. its direct footprint) and its immediate environs (e.g. for the case of discharges, emissions) where direct impacts are expected to take place; whereas the "Indirect Area of Influence" is expected to be a wider area that may vary significantly depending on the receptor.

Risks and impacts resulting from accidental events and their mitigation are assessed in Section 8.9. Cumulative impacts arising from the combination of activities associated with the Project, together with other third-party developments or projects in the same area of influence, are assessed in Section 8.10.

Each impact assessment discussion is presented in a systematic manner detailing the following:

- Prediction of Impacts: to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities.
- Evaluation of Impacts: to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor.
- Mitigation and enhancement: to identify appropriate and justified measures to mitigate negative impacts and enhance positive impacts.
- Residual impact evaluation: to evaluate the significance of impacts assuming effective implementation of mitigation and enhancement measures.

A summary table of the assessment of the potential environmental impacts of the proposed Project activities per project phase is provided in Section 8.12, along with potential and residual scorings of impact severity.

8.5 Environmental Impact Assessment

The following section presents the potential impacts of the Project activities on the environment, i.e. air quality, noise, soil quality, groundwater, landscape and visual, terrestrial ecology and habitats, terrestrial, seawater quality and sediment quality, marine ecology and habitats, and sensitive species.

8.5.1 Air quality (AQ)

8.5.1.1 Impact Identification

Table 8-15 presents the key potential impacts of the Project on the local air quality conditions. Further detailed assessment is carried out in the next subsections.

Table 8-15 Key Potential Impacts – Air Quality

Construction and Commissioning phase	Operation phase	Decommissioning phase
AQ1 – Reduced ambient air quality caused by vehicles and machinery involved in construction activities.	AQ2 - Reduced ambient air quality caused by LNG start-up activity. AQ3 – Reduced ambient air quality caused by LNG normal operation phase. AQ4 - Reduced ambient air quality caused by vessel loading activities.	AQ5 - Reduced ambient air quality caused by vehicles and machinery involved in dismantling activities.

8.5.1.2 Key Considerations

All Project phases has the potential to generate air pollutants' emissions and impacts to the ambient air quality conditions of the environment in the surroundings of the LNG site. Box 8-3 presents the key sources of impacts, baseline, and project factors influencing the impact and relevant existing Project controls/mitigation embedded measures.

Box 8-1 Key Considerations for Assessment - Air Quality

Sources of Impact

- Construction: Land excavation, digging, pipe laying, back filling, construction vehicle movements, upgrade of access roads and fugitive emissions from stored chemicals/hazardous waste.
- Operations: Operation of combustion equipment (i.e., incinerator, flare and generators), operation of jetty and pipeline, fugitive emissions from stored chemicals/hazardous waste, fuel and chemical consumption, operation of LNG train (i.e., compressors), sources of fuel gases (i.e., boil off gas unit, amine flash gas, and nitrogen removal unit).
- Decommissioning: Land excavation, removal of temporary structures, heavy machinery and vehicles, fugitive emissions from stored chemicals/hazardous waste.

Particular Baseline Conditions that Potentially Influence Impacts

- Presence of receptors: Majis community >2km from the site.
- Project is located in an industrial area (Sohar Industrial Port, see Chapter 4.1.5 related to air quality baseline conditions).

Project Factors that Potentially Influence Impacts

- Duration of construction activities (34 months).
- Pipeline alignment will run along existing utility corridors in the Sohar port and may be buried.
- Nitrogen gas and Boil Off Gas to be recovered and reused in the Project (See Chapter 3.7.7 Project Description).

Relevant Existing Controls/Mitigations for Construction and Decommissioning

- Compliance with MD41/2017.

- Wet dust suppression.
- Covering of stockpiles of excavated material.
- Operation and servicing of machinery and vehicles as per manufacturer recommendations.

Relevant Existing Controls/Mitigations for Operations

- Compliance with MD 41/2017 and MD 118/2004.
- Pressure control and metering stations, filtering system (to remove particulate matter from feed gas) and overpressure protection system to be implemented in the inlet facilities.
- Boil Off Gas produced during the unloading operation will be recovered and recycled in the process.
- Flaring will be only allowed during start-up, shut down and emergency situations. The plant is designed as a zero-flaring plant, where all the normal flaring base design case emissions have been eliminated at the design stage.
- The initial start-up flare will be carried out reducing the hydrocarbon being flared using nitrogen.
- Power will be provided from the existing electrical grid (i.e., generators are only used as back-up).
- Removal units for: mercury, acid gas, heavy hydrocarbon, nitrogen, and methane.

The following subsections present the impact evaluation during the three project phases.

8.5.1.3 Impact Assessment

Construction and Commissioning Phase

AQ1 – Reduced ambient air quality caused by vehicles and machinery involved in construction activities.

During the construction phase, the main sources of emissions[129] are:

- heavy machinery and vehicles: front loaders, trucks, compactors and pickups used for construction activities such as civil works and construction works and for the transport of materials and workers;
- engine driven equipment and energy generators used to supply electricity during construction activities.

During the construction phase, exhaust emissions will be generated by the use of motorized vehicles and equipment (e.g. trucks, generators) from the combustion of hydrocarbons. These emissions may cause an increase in pollutant concentrations in the atmosphere, such as carbon monoxide (CO), nitrogen oxides (NOx) and sulphur dioxide (SO2), from exhaust fumes. Exhaust emissions may also be generated by equipment at the accommodation camp.

Dust emissions will be mainly caused by excavation activities and by dust resuspension due to the wind on exposed surfaces and vehicles movements particularly on unpaved surfaces. Emissions of particles and dust during the construction phase are by nature highly variable. The potential impacts associated to dust emissions during the construction phase depends to a great extent on the type of soil, the type of activities, the prevalence of hot, dry weather during the work, the speed of prevailing winds and the ability of the wind to carry particles and dust towards potential sensitive receptors.

Therefore, construction activities are likely to generate relatively low amounts of emissions that are typically limited to the Project site (**local** extent) and will be generated intermittently over a **temporary** duration (~34 months) from both mobile (i.e., vehicles) and stationary sources (i.e., generators). Despite the **long-term** nature of the impact, given the previous characteristics, the impact magnitude is **small**.

[129] The magnitude of the incremental impact of emissions due to vessel activities during the construction is considered negligible, given the small volume of additional shipping traffic that is attributable to the project during the construction period.

Even if receptors in the vicinity of the Project are sensitive to air quality issues, they are more than 2 km away from the Project (with the exception of site workers), therefore, receptor sensitivity is considered to be **medium** given the baseline PM concentration observed in the project area. As such, the overall impact significance is **minor**. The cumulative impact of the various emission sources in the port in addition to the proposed project is described in Section 8.10. Air quality related impacts caused by unplanned events (i.e., upset plant conditions) are also further discussed in Section 8.9.

Potential impact descriptors for AQ1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Temporary	Local	Small	Medium	**Minor**

Operation and Maintenance Phase

An air dispersion modelling study was developed by SIPC in 2023 by means of the AERMOD model tool to support the assessment of impacts on air quality arising during the LNG start-up phase (AQ2) and during normal operations of the LNG plant (AQ3). AERMOD is considered appropriate for this type of assessment, being a dispersion model that is recognised internationally by a number of authorities in the air quality an impact assessment community (i.e. USEPA, IFC).

Three different emission scenarios were assessed:

- AQ1: Current operational scenario (SPF in operation and baseline concentration, without LNG contribution);
- AQ2: Current operational scenario (SPF in operation and baseline data) + Contribution of LNG start-up operation
- AQ3: Current operational scenario (SPF in operation and baseline data) + Contribution of LNG normal operation

For all three emission scenarios, the following pollutants of interest were modelled: Nitrogen oxides ($NO_{x,}$ assuming full conversion to NO_2), Sulphur dioxide (SO_2); Carbon oxide (CO) and Particulate Matter (PM_{10}). In addition, nonmethane hydrocarbons (NMHC) were modelled only for the contribution of LNG during normal operation (AQ3) due to the lack of information related to this pollutant for the current operational scenario. The modelling results were compared with the air quality standards set in MD 41/2017 and to IFC air quality limits to highlight any evidence of exceedance of the applicable limits due to LNG operations.

In accordance with the impact assessment methodology reported in Section 8.2 of the ESIA, the modelling study supported the impact assessment by determining the following factors:

- magnitude of impacts on the basis of the comparison of model output against applicable air quality guideline values; and
- extent of impacts on the basis of the spatial distribution of predicted concentrations.

The following paragraphs provide a summary of the results of the modelling study and the assessment of the significance of impacts on air quality during the start-up and normal operation phases. The details of the modelling study are reported in Appendix C.

AQ2 – Reduced ambient air quality caused by LNG start-up activity

During LNG start-up, the emission sources are:

- the fire heater, with the primary pollutants of interest being Nitrogen oxides (NO_x, assuming fully converted to NO_2), Sulphur dioxide (SO_2); Carbon oxide (CO) and Particulate Matter (PM_{10}).
- the flaring system ("warm"/"cold" flares), emitting NO_x and CO.

For the simulation of the emissions generated by the flaring performed by SOHAR Port/Freezone in 2023, the methodology EPA-454/R-92-024 Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised) was applied. The following box reports a brief description of the EPA methodology applied for the modelling of the LNG start-up phase.

Box 8.2 Methodological Approach for Flare Emissions Modelling based on EPA-454/R-92-024

Flares are commonly used as a control device for a variety of sources. A high-temperature oxidation process takes place in the flares and allows to burn combustible components, mostly hydrocarbons, contained in waste gases, or in excess gases, likely to be generated in emergency, plants' shut down or start up condition.
The main problems in simulating gaseous emissions from a flare are related to the emissions' calculation and to their dispersion modelling. In the dispersion modelling, the buoyancy force associated with radiative heat losses and the flame length in estimating plume height, have to be taken into account.

Mass Emission Rate
The formula used to calculate the generic emission rate of flare combustion products is the following:

$$Q_m(g/s) = \frac{(Vol(\%)/100) \cdot V(m^3/s) \cdot M_W(g/g-mol) \cdot (1-TOE)}{0.0224 \cdot (m^3/g-mol)}$$

Where:
Vol (%): volume fraction of pollutant;
V (m3/s): volumetric flow rate to the flare;
MW (g/g-mole): molecular weight of material released; and
TOE: Thermal Oxidation Efficiency (usually higher than 99%, up to 99,9%)

Heat Release Rate
The following equation (Lahey & Davis, 1984) is used to calculate the total heat release rate from the flare gas combustion:

$$H_r = 44.64 \cdot V \sum_{i=1}^{n} f_i H_i$$

Where:
Hr (J/s): total heat release rate;
fi: volume fraction of each component of the flare input gas;
Hi (J/g-mole): net heating value of each component; and
n: components of the flare input gas stream.

Where the value 44.6 is derived for air as:

$$\frac{\rho_{air}(g/m^3)}{M_W(g/g-mole)} = \frac{1292}{28.97} = 44.6(g-mole/m^3)$$

Effective Release Height
Lastly, the effective release height is calculated by adding the flare height to the stack height, as follows (Beychok, 1979):

$$H_{sl} = H_s + 4.56 \times 10^{-3} \left(\frac{H_r}{4.1868} \right)^{0.478}$$

Where:
Hsl (m): effective release height before plume rise;
Hs (m): physical stack height above ground; and
4.1868 is a conversion factor: Joules to calories.

The dispersion model used for the simulation estimates the “Plume raise” on the basis of the effective release height calculated as presented above.

Industrial Flare Emission Factors
The emission factors used to calculate the NOx and CO and PM10 flow rate are presented below. These are proposed by U.S. EPA in the technical document Emissions Factors & AP-42, Compilation of Air Pollutant Emission Factors (chapter 13.5 Industrial Flares,):

- NO_x = 2.92 x 10^{-5} [g/KJ] (EPA_AP42_13.5 Industrial Flares, update April 2018);
- CO = 1.59 x 10^{-4} [g/KJ] (EPA_AP42_13.5 Industrial Flares, update April 2018);
- PM_{10} = 5.16 x 10-5 [g/KJ] (Emissions Estimation Protocol for Petroleum Refineries, April 2015, based on EPA_AP42_13.5 Industrial Flares).

Table 8-16 summarises the results of the model simulations performed by SOHAR Port/Freezone in 2023 to evaluate the air pollutants' concentration levels generated during the LNG start-up and comparison with the current operational scenario (baseline conditions, only SPF in operation).

The results of the modelling study highlighted that:

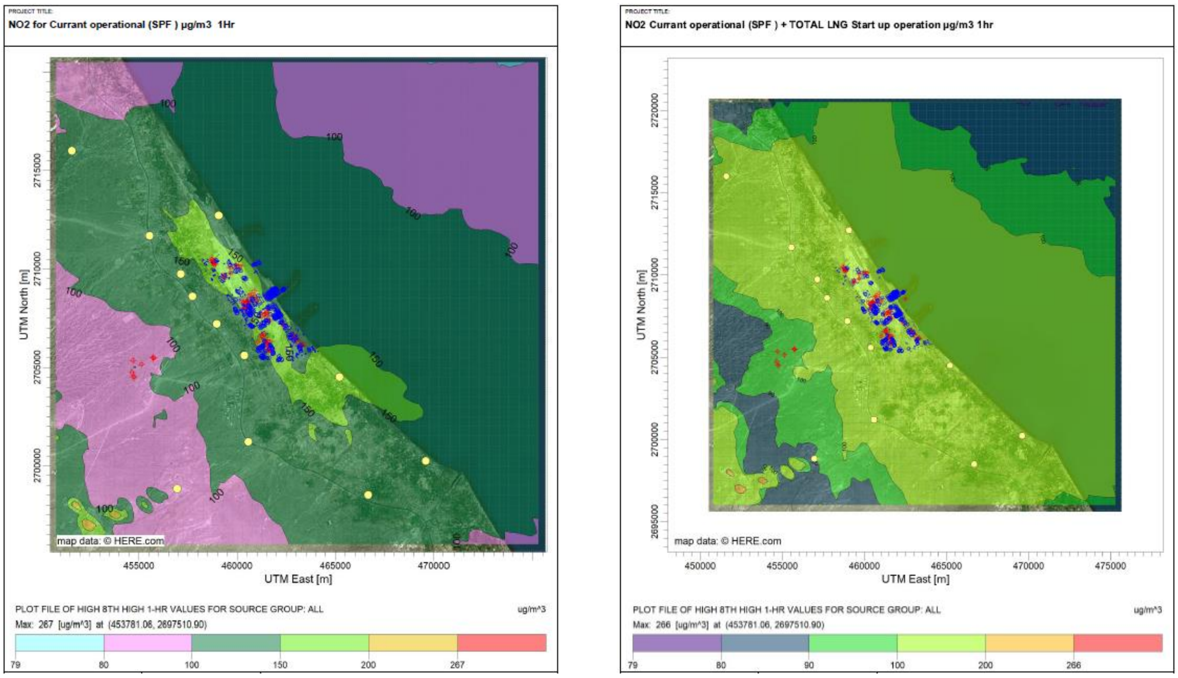
- the modelled pollutant concentrations still comply with the air quality standards set by MD 41/2017 for all pollutants of interest (i.e., NO_2, SO_2, CO and PM_{10}) at all assessed receptors (see Appendix C for further details);
- NO_2, SO_2 and CO modelled concentrations comply at all assessed receptors with the IFC Environmental, Health, and Safety (EHS) Guidelines 2007. The same is not true for PM_{10} long-term, due to local airshed currently with the PM_{10} baseline annual concentration equal to 134.30 µg/m^3 (see Section 4.1.5.1). However the emissions generated by the Project result to have a negligible impact on this value (see Appendix C for further details);
- Compared to the Current operational scenario (baseline conditions), the increase generated by LNG start-up emissions in ground level concentrations is negligible for all air pollutants of interest:
  - a null increase was modelled for PM10 (24 h period) and negligible increase for PM10 (1 yr period);
  - an average increase ranging between 0.01% and 0.04% for CO (1hr period) and between 0.01% and 0.03% for CO (8hr period);
  - an average increase ranging between 0.02% and 0.03% for both NO_2 (1hr period) and NO_2 (24hr period), negligible increase for NO_2 (1yr period);
  - a null increase for SO_2 (1hr period), for SO_2 (24hr period) and for SO_2 (1yr period).

This is clearly evident also comparing the ground level concentration maps for NO_2, PM10 and SO_2 for the Current operational scenario and the future scenario (Current + LNG Start-up contribution) reported in Figure 8-7 to Figure 8-9, where there is no evidence of significant differences in the air emissions footprint between the two scenarios.

Table 8-16 Modelling Results for LNG Start-up Operation

	Current operational (SPF), µg/m³										Current operational (SPF) + LNG startup, µg/m³									
	PM		CO		NO2			SO2			PM		CO		NO2			SO2		
Location	**24h**	**1yr**	**1hr**	**8hr**	**1hr**	**24hr**	**1yr**	**1hr**	**24hr**	**1yr**	**24h**	**1yr**	**1hr**	**8hr**	**1hr**	**24hr**	**1yr**	**1hr**	**24hr**	**1yr**
Location	24h	1yr	1hr	8hr	1hr	24hr	1yr	1hr	24hr	1yr	24h	1yr	1hr	8hr	1hr	24hr	1yr	1hr	24hr	1yr
1. Zafran Station	139.55	135.14	633.35	386.99	122.38	45.02	27.37	63.34	18.45	9.64	139.55	135.14	648.26	390.24	124.66	45.24	27.4	63.34	18.45	9.64
2.Ghadfan South Station	142.18	135.85	644.71	368.24	116.42	37.32	29.33	83.13	20.58	12.3	142.18	135.85	669.62	377.83	120.07	37.97	29.54	83.13	20.58	12.3
3.Ghadfan North Station	145.01	138.11	599.15	341.1	118.79	41.94	33.39	81.38	21.35	12.59	145.01	138.11	624.33	349.61	122.49	42.5	33.58	81.38	21.35	12.59
4. Aqdat Al Mawani'a Station	140.59	136.08	613.74	393.01	121.05	44.51	31.74	65.79	16.36	10.61	140.59	136.08	634.93	399.43	124.07	45.03	31.81	65.79	16.36	10.61
5. AL Hadd	140.3	136.18	603.85	353.99	113.43	38.21	31.32	69.35	17.77	10.86	140.3	136.18	623.57	362.98	116.68	38.8	31.43	69.35	17.77	10.86
6. Harmoul	140.11	135.22	775.86	420.31	135.88	36.48	26.56	74.86	15.89	9.24	140.11	135.22	797.24	424.39	138.76	36.77	26.6	74.86	15.89	9.24
7. Liwa RA	140.72	134.86	577.2	372.14	136.44	38.71	26.54	71.83	15.54	9.162	140.72	134.86	594.59	376.9	138.98	39.03	26.58	71.83	15.54	9.162
8. New Liwa	137.07	134.57	530.06	363.48	103.75	35.02	25.62	55.49	13.53	8.794	137.07	134.57	543.26	366.66	105.42	35.19	25.64	55.49	13.53	8.794
9. FAQ RA	137.64	134.57	609.78	354.68	102.18	35.03	26.59	63.03	15.32	9.215	137.64	134.57	626.7	359.88	104.89	35.38	26.66	63.03	15.32	9.215
10. Majees	145.09	134.77	793.26	430.73	159.63	57.06	28.91	92.16	29.2	10.63	145.09	134.77	816.05	435.89	163.37	57.4	28.96	92.16	29.2	10.63
11. Al Ghushbh	138.33	136.86	727.14	380.73	118.49	37.61	26.32	71.56	14.75	9.124	138.33	136.86	741.54	385.68	120.81	37.91	26.36	71.56	14.75	9.124
12. Majan	136.93	134.71	1088.4	524.71	88.8	31.67	26.15	58.17	12.47	9.074	136.93	134.71	1102.48	529.31	90.76	31.97	26.22	58.17	12.47	9.074
Limits/Guidelines	***150 [1]***	***70 [2]***	***30,000 [1]***	***10,000 [1]***	***250 [1]***	***130 [1]***	***40 [2]***	***350 [1]***	***150 [1]***	***125 [2]***	***150 [1]***	***70 [2]***	***30,000 [1]***	***10,000 [1]***	***250 [1]***	***130 [1]***	***40 [2]***	***350 [1]***	***150 [1]***	***125 [2]***

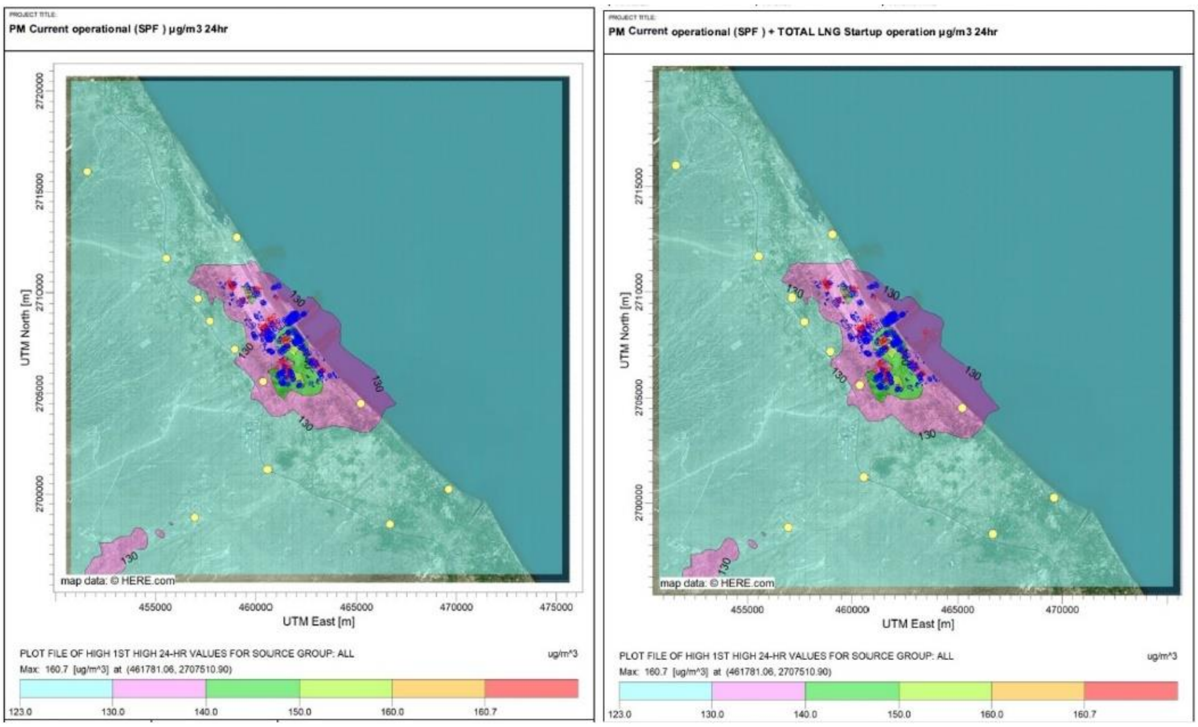
Source: Comprehensive Air Dispersion modeling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan)

Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023.

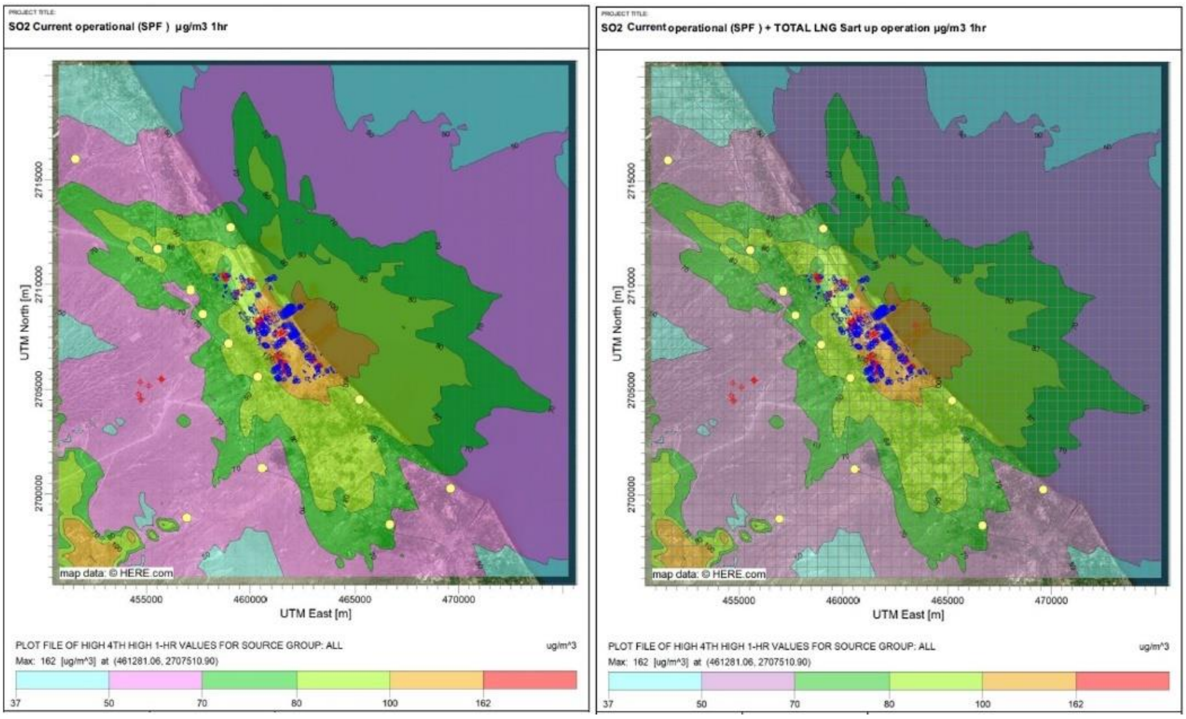
Figure 8-7 NO2 1-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C)



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan)

Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023.

Figure 8-8 PM 24-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C)



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan).

Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023

Figure 8-9 SO_2 1-hour Ground Level Concentrations during LNG Start-up Operation (Extract from Appendix C)

The start-up phase will occur at the end of the construction phase and will be limited in duration, although a **long-term** duration of the impacts on air quality is expected, Project emissions are modelled to be well below the national air quality standards and resulting in a negligible increase in ground level concentrations of air pollutants compared to the current baseline conditions. Thus, the magnitude of the potential impacts to sensitive receptors is **small**. Receptor sensitivity is considered to be **medium** given the baseline PM concentration observed in the project area. Overall significance of the impact is **minor**.

Potential impact descriptors for AQ2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Temporary	Local	Small	Medium	**Minor**

AQ3 – Reduced ambient air quality caused by LNG normal operations

During LNG normal operations, the routine emission sources are:

- the fire heater, with the primary pollutants of interest being Nitrogen oxides (NO_x, assuming fully conversion to NO_2), Sulphur dioxide (SO_2); Carbon oxide (CO) and Particulate Matter (PM_{10}).
- the thermal oxidator, emitting NO_2, SO_2 and PM_{10}.

Based on the background air quality concentrations measured from 2019 to 2021 (see Section 4.1.5), all monitored air pollutants' concentrations below the national air quality standards set by MD 41/2017, but PM_{10} annual concentration is above the IFC guidelines.

Table 8-7 summarises the results of the simulations performed by SIPC in 2023 to evaluate the air pollutants' concentration levels generated during the LNG start-up and comparison with the current operational scenario (only SPF in operation). The results of the modelling study highlighted that:

- the modelled pollutant concentrations still comply with the air quality standards set by MD 41/2017 for all pollutants of interest (i.e., NO_2, SO_2, CO and PM_{10}) at all assessed receptors (see Appendix C for further details);
- NO_2, SO_2 and CO modelled concentrations comply at all assessed receptors with the IFC Environmental, Health, and Safety (EHS) Guidelines 2007. The same is not true for PM_{10}, due to local airshed with the PM_{10} baseline annual concentration equal to 134.30 µg/m^3. However, the emissions generated by the Project have a negligible contribution to annual PM_{10} concentration (see Appendix C for further details);
- compared to the Current operational scenario (baseline conditions), the increase generated by LNG normal operation emissions in ground level concentrations is negligible for all air pollutants of interest:
  - an average increase ranging around 0.01% was modelled for PM10 (24 hr period) and negligible increase for PM10 (1 yr period);
  - negligible increase for CO (1 hr period), for CO (8hr period);
  - an average increase around 0.01% for NO_2 (1 hr period) and for NO_2 (24hr period), negligible increase for NO_2 (1yr period);
  - an average increase ranging between 0.03% and 0.05% for SO_2 (1 hr period) and between 0.01% and 0.02% for SO_2 (24 hr period).

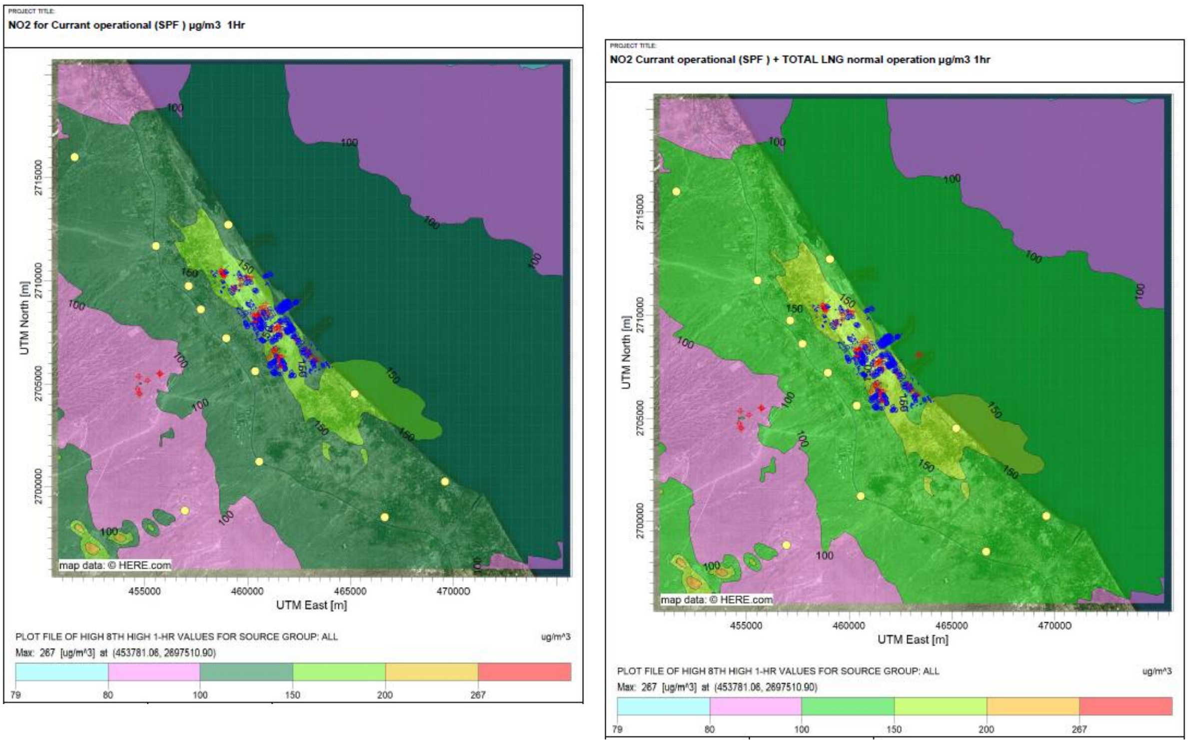
This is clearly evident also comparing the ground level concentration maps for NO_2, PM_{10} and SO_2 for the Current operational Scenario and the Future Scenario (Current + LNG Normal Operation contribution) where there is no evidence of significant differences in the air emissions footprint between the two scenarios.

Table 8-17 Modelling Results for LNG Normal Operation

	Current operational (SPF), $\mu g/m^3$										Current operational (SPF) + LNG startup, $\mu g/m^3$									
	PM		CO		NO2			SO2			PM		CO		NO2			SO2		
Location	**24h**	**1yr**	**1hr**	**8hr**	**1hr**	**24hr**	**1yr**	**1hr**	**24hr**	**1yr**	**24h**	**1yr**	**1hr**	**8hr**	**1hr**	**24hr**	**1yr**	**1hr**	**24hr**	**1yr**
1. Zafran Station	139.55	135.14	633.35	386.99	122.38	45.02	27.37	63.34	18.45	9.64	139.56	135.14	633.35	386.99	122.9	45.08	27.373	65.57	18.7	9.65
2.Ghadfan South Station	142.18	135.85	644.71	368.24	116.42	37.32	29.33	83.13	20.58	12.3	142.19	135.85	644.71	368.24	117.06	37.36	29.333	86.24	20.75	12.31
3.Ghadfan North Station	145.01	138.11	599.15	341.1	118.79	41.94	33.39	81.38	21.35	12.59	145.03	138.11	599.15	341.1	119.35	42.03	33.393	84.45	21.75	12.6
4. Aqdat Al Mawani'a Station	140.59	136.08	613.74	393.01	121.05	44.51	31.74	65.79	16.36	10.61	140.6	136.08	613.74	393.01	121.62	44.58	31.742	68.65	16.66	10.62
5. AL Hadd	140.3	136.18	603.85	353.99	113.43	38.21	31.32	69.35	17.77	10.86	140.31	136.18	603.85	353.99	114.09	38.28	31.322	72.33	18.08	10.87
6. Harmoul	140.11	135.22	775.86	420.31	135.88	36.48	26.56	74.86	15.89	9.24	140.12	135.22	775.86	420.31	136.46	36.54	26.562	77.42	16.14	9.25
7. Liwa RA	140.72	134.86	577.2	372.14	136.44	38.71	26.54	71.83	15.54	9.162	140.73	134.86	577.2	372.14	136.96	38.75	26.543	74.12	15.72	9.17
8. New Liwa	137.07	134.57	530.06	363.48	103.75	35.02	25.62	55.49	13.53	8.794	137.08	134.57	530.06	363.48	104.18	35.05	25.621	57.4	13.68	8.8
9. FAQ RA	137.64	134.57	609.78	354.68	102.18	35.03	26.59	63.03	15.32	9.215	137.65	134.57	609.78	354.68	102.62	35.06	26.591	65.17	15.44	9.22
10. Majees	145.09	134.77	793.26	430.73	159.63	57.06	28.91	92.16	29.2	10.63	145.11	134.77	793.26	430.73	160.26	57.17	28.911	94.86	29.68	10.66
11. Al Ghushbh	138.33	136.86	727.14	380.73	118.49	37.61	26.32	71.56	14.75	9.124	138.34	136.86	727.14	380.73	118.93	37.64	26.327	73.46	14.89	9.13
12. Majan	136.93	134.71	1088.4	524.71	88.8	31.67	26.15	58.17	12.47	9.074	136.94	134.71	1088.4	524.71	89.38	31.72	26.151	60.84	12.69	9.08
Limits/Guidelines	***150*** (1)	***70*** (2)	***30,000*** (1)	***10,000*** (1)	***250*** (1)	***130*** (1)	***40*** (2)	***350*** (1)	***150*** (1)	***125*** (2)	***150*** (1)	***70*** (2)	***30,000*** (1)	***10,000*** (1)	***250*** (1)	***130*** (1)	***40*** (2)	***350*** (1)	***150*** (1)	***125*** (2)

(1) AQS MD 41/2017
(2) IFC Environmental, Health, and Safety Guidelines for Air Emissions and Ambient Air Quality, 200

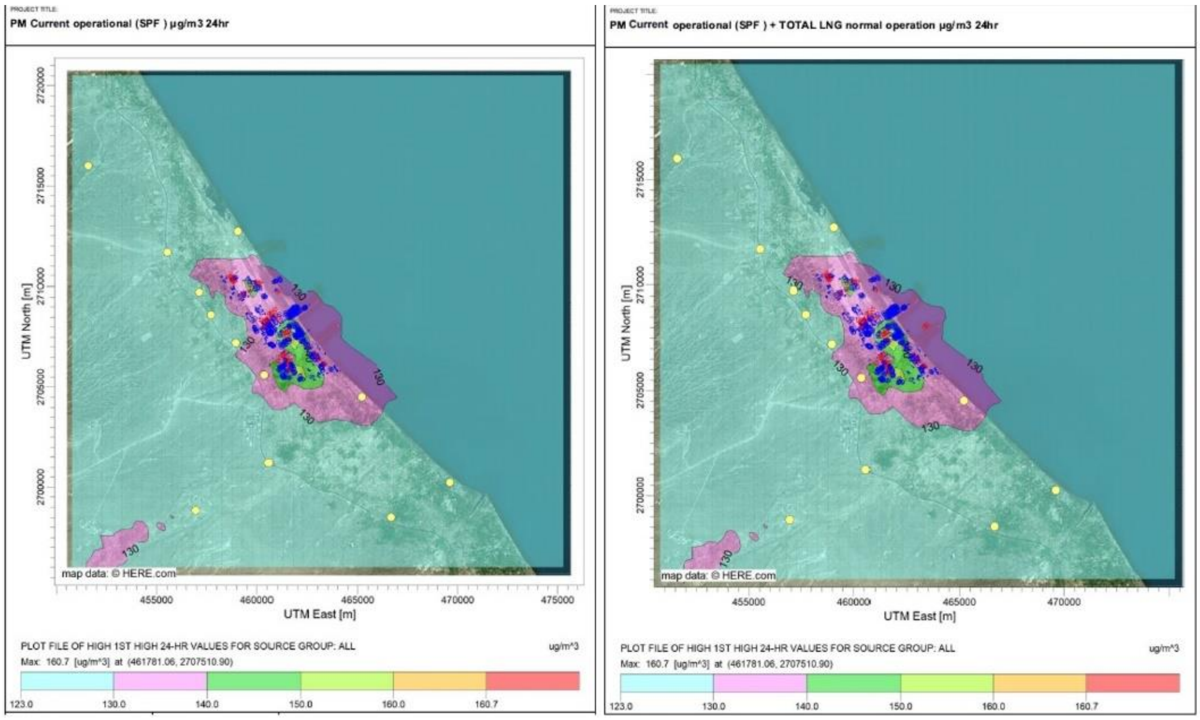
Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023.



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan).

Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023

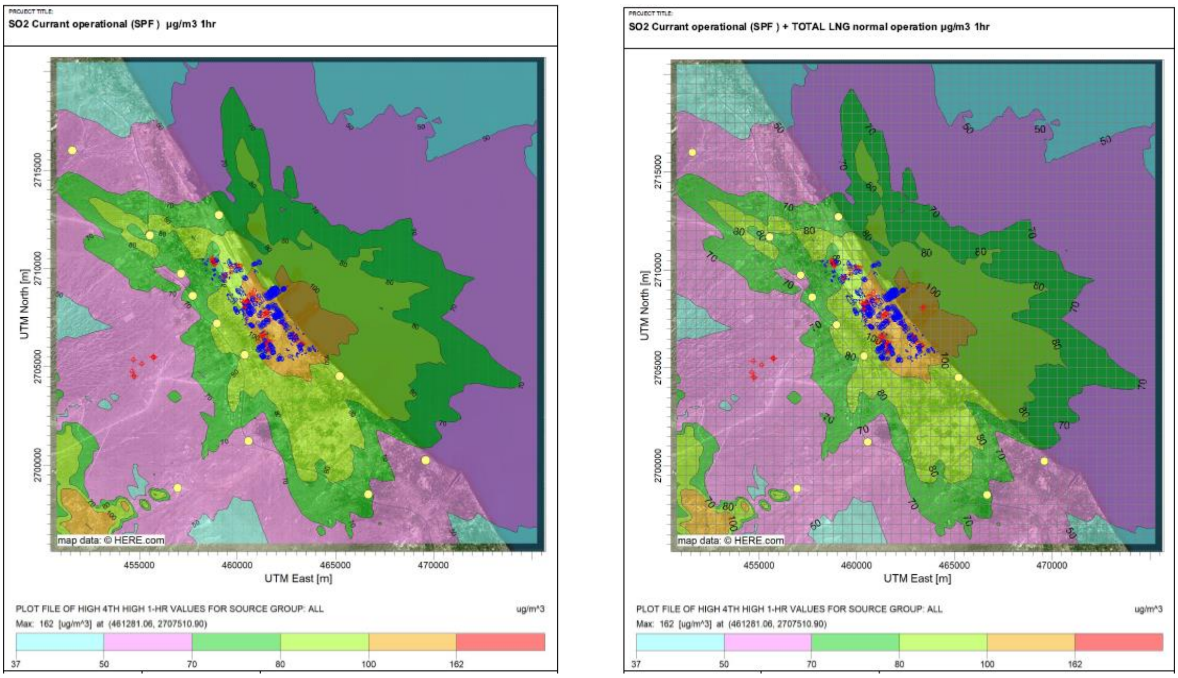
Figure 8-10 NO_2 1-hour Ground Level Concentrations during LNG Normal Operation (Extract from Appendix C)



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan).

Source: Comprehensive Air Dispersion modeling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO2) to ambient air. SOHAR, 2023.

Figure 8-11 PM 24-hour Ground Level Concentrations during LNG Normal Operation (Extract from Appendix C)



Note: Yellow dots represent sensitive receptors (Zafran AQMN Station, Ghadfan South AQMN Station, Ghadfan North AQMN Station, Aqdat Al Mawani'a AQMN Station, Al Hadd, Harmoul, Liwa RA, New Liwa, FAQ RA, Majees, Al Ghushbh, and Majan).

Source: Comprehensive Air Dispersion modelling for MARSA LNG LLC Plant emission (CO, NOx, PM and SO_2) to ambient air. SOHAR, 2023.

Figure 8-12 SO2 1-hour Ground Level Concentrations during Normal Operation (Extract from Appendix C)

Although the LNG normal operations result in an increase in the current ambient air quality concentrations, the results of the modelling study highlighted that the modelled pollutant concentrations still comply with the national air quality standards for all pollutants of interest (i.e., NO_2, SO_2, CO and PM_{10}) at all assessed receptors (see Appendix C for further details) and that the increase compared to the current baseline conditions is negligible.

Moreover, the maximum concentration levels (still compliant with applicable air quality standards) are confined within the LNG site whilst the closest receptors to the LNG are located 2 km from the LNG plant, sufficiently distant to not be reached by significant concentrations of the modelled pollutants (see Appendix C for further details).

Although the long-term nature of the impact (~25 years), results of Project emissions modelling indicate that air pollution will remain below legislated limits, therefore, the magnitude of the potential impacts to sensitive receptors is **small.** Receptor sensitivity is considered to be **medium** given the baseline PM concentration observed in the project area. Overall significance of the impact is **minor.** Impact significance in a cumulative context is described in section 8.10 – Cumulative Impacts.

Potential impact descriptors for AQ3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Continuous	Local	Small	Medium	**Minor**

AQ4 – Reduced ambient air quality caused by vessel movement and loading

Emissions from tugs and LNG vessels, especially when the vessel is in proximity to the coast, may represent an important source of air pollutants (e.g. NOx, CO, SO_2). Even if emissions generated by vessels are not modelled, their effect is likely to be less localized than flaring and only temporary, and likely to cause impacts only to receptors located near the coast. Impact magnitude is thus predicted to be **small.**

Receptor sensitivity, mainly for those located near the coast, is considered to be **medium** given the baseline PM concentration observed in the project area. Nearby settlements may have grievances related to bad odours and perceived poor ambient air quality. Overall significance of the impact is **minor.**

Potential impact descriptors for AQ4						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Temporary	Local	Small	Medium	**Minor**

Decommissioning Phase

AQ5 – Reduced ambient air quality caused by vehicles and machinery involved in dismantling activities

Air emissions during this phase will mainly consist in exhaust emissions and emission of dust generated by the machinery used during abandonment procedure and vehicles for transporting away the equipment present at the Project site.

Emissions from combustion will result from diesel engine vehicles and machinery used during the activities and can be assessed as presented for vehicles involved in the construction phase described above (AQ1). However, they are expected to be small, due to the transient and temporary nature of the different abandonment activities and equipment. Moreover, control measures embedded in project design relevant to air quality include the proper maintenance of vehicles and machinery to avoid unnecessary or excess exhaust emissions.

Due to the **temporary** duration of the activity and its **local** extent, impact magnitude is considered to be **small**.

Although these activities will likely directly impact the ambient air quality, the receptor sensitivity is considered to be **medium** given the baseline PM concentration observed in the project area. Consequently, the overall impact significance is **Minor.**

Potential impact descriptors for AQ5						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Temporary	Local	Small	Medium	**Minor**

8.5.1.4 Mitigation measures

The preferred method for controlling air pollutants from stationary sources is to implement air quality control measures at the source. Recommended mitigation measures for potential air quality impacts are as follows.

General Mitigation Measures

- Air emission specifications in compliance with best practice and legal requirements should be considered during all equipment selection and procurement;
- Use of available fuels on the Omani market with minimum sulphur content;
- Regular maintenance (as per manufacturers recommendations) of vehicles, machinery, and equipment in order to minimise the generation of air pollutants;
- Atmospheric emissions from all transport vehicles used during the different phases of the Project will be reduced by optimizing the number of journeys as far as possible;
- It will be ensured that vehicles and machines will be turned off when they are not being used;
- Implementation of a grievance mechanism in the event of complaints related to Air quality (i.e., dust generation etc.). Access methodology to the grievance mechanism (e.g., telephone and email address of responsible person) must be clearly advertised at a publicly accessible location associated with the Project (e.g., entrance to the facility). All complaints and communication with persons/organisations lodging complaints must be documented in a complaint register in conjunction with a description of how complaints are being or were solved. The complaint register must be made available to SIPC (or other relevant authority) for review when requested.

Construction and Commissioning Phase

- Limit construction during extreme weather conditions (e.g., high wind and dust storms) that can intensify dust generated from construction activity;
- Construction activities associated with high dust (and other air emissions) generation (e.g., grading and excavation) must be avoided as far as possible at night, when it is difficult to visibly assess air emissions. If construction activities are unavoidable during these periods, sufficient lighting and/or monitoring must be implemented to ensure air emissions are not elevated above normal visible working conditions;
- Avoid or reduce (as far as practicable) Project vehicle traffic near communities and ensure vehicles follow journey management plans with designated routes;
- Suitable management and maintenance of raw materials' storage areas to minimize clouds of particles;
- Tarpaulin coverings on trucks during the transport of crumbly building materials or excavated earth or backfill;
- Speed restrictions for vehicles travelling on non-asphalted roads;

- Utilise grizzlies, railings or grates at the site exit points to dislodge the excess dirt and mud on vehicle wheels and under carriages; and
- Utilise dust suppression techniques (e.g., spraying) on unpaved access roads in order to minimise dust generation.

Operation and Maintenance Phase

- Flaring will only occur during the start-up, shut down and in emergency situations as all the previous operating flaring cases have been eliminated at the design stage. The initial start-up flaring will be carried out with a lower amount of hydrocarbon being flared thanks to the use of nitrogen;
- Flare stack design as per best practise will be ensured, so to facilitate the dispersion of emitted pollutants during the start-up, shut down and in emergency situations;
- Implementation of a grievance mechanism in the event of complaints related to air quality.
- Ensure design specifications for combustion sources are in compliance with local legislations and international standards;
- Ensure feasible cost-effective options for reducing air emissions (e.g., wet suppression, exhaust filters etc.) are implemented;
- LNG vessel loading activities to comply with international standards (e.g., International Maritime Organization codes, Society for International Gas Tanker and Terminal Operators guidelines) and codes relating to hull requirements, cargo containment, pressure/temperature controls, and fire protection;
- Boil off gas generated on site will be recovered and recycled in the LNG liquefaction process; and
- Leak detection and repair programmes must be implemented and the selection of valves, flanges, fittings, seals, and packings must consider safety and suitability requirements, as well as their capacity to reduce gas leaks and fugitive emissions (as per IFC best practices).

Decommissioning Phase

- Mitigation outlined for the construction and commissioning phase must be implemented.

8.5.1.5 Residual impacts

While potential impacts from construction and decommissioning phases have **Minor** significance, mitigation measures are proposed in addition to existing controls (i.e., filtering systems and metering stations) outlined in the Project Description. Project controls and additional mitigation measures, however, cannot completely prevent the emission of air pollutants. Therefore, a **minor** residual impact is anticipated.

For operation, impacts have a **Minor** significance, being air emissions concentration levels below the air quality standards set by national legislation and the increase in the current ground level concentrations (baseline conditions) negligible. Despite the implementation of mitigation measures and careful equipment selection, combustion sources will still emit air pollutants, albeit at lower levels. Ambient air quality and source emission monitoring should be conducted to ensure that ambient air quality is in line with local legislated limits. Monitoring will be conducted as per the methodology outlined in Section 9.5.3 under the respective management plans.

Residual air quality impacts are further discussed in the context of cumulative impacts in Section 8.10.

Residual impact descriptors for Construction and Decommissioning Phases						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Temporary	Local	SMALL	Medium	**Minor**
Residual impact descriptors for LNG Start-up Phase						
Direct	Long-term	Temporary	Local	SMALL	Medium	**Minor**
Residual impact descriptors for LNG Normal Operation Phase (including vessels loading)						
Direct	Long-term	Continuous	Local	SMALL	Medium	**Minor**

8.5.2 Noise Emissions (N)

8.5.2.1 Impact Identification

Table 8-18 presents the key potential impacts of the Project on the local acoustic climate. Further detailed assessment is carried out in the next subsections.

Table 8-18 Key Potential Impacts – Noise

Construction and Commissioning phase	Operation phase	Decommissioning phase
N1 – Noise emissions from construction equipment, machineries and vehicles, potentially affecting the acoustic climate and generating nuisance to near population.	N2 – Noise emissions from the LNG operations, potentially affecting the acoustic climate and generating nuisance to near population.	N3 - Noise emissions from dismantling equipment and machineries, potentially affecting the acoustic climate and generating nuisance to near population.

8.5.2.2 Key Considerations

All Project phases have the potential to generate noise emissions and impacts to the population located in the near surroundings of the LNG site. Potential noise impacts to humans include sleep disturbance, an increased incidence of social and behavioural problems (including annoyance and increased aggressive behaviour) and in extreme cases, hearing impairment.

Box 8-3 presents the key sources of impacts, baseline, and project factors influencing the impact and relevant existing Project controls/mitigation embedded measures.

Box 8-3 Key Considerations for Assessment - Noise

Sources of Impact

- Construction: civil works, excavation works, construction of LNG buildings and installation of temporary site facilities, jetty construction works, pipeline installation works, construction vehicle movements.
- Operations: operation of LNG equipment, maintenance works, personnel's' vehicles movements.
- Decommissioning: demolition works, dismantling vehicle movements.

Particular Baseline Conditions that Potentially Influence Impacts

- Presence of receptors: Majis Maritime College (~1.5km), Majis community >2km from the site.
- Existing sources of noise of the Sohar Industrial Port.

- Project area is classified as an Industrial Zone.

Project Factors that Potentially Influence Impacts

- Pipeline running along existing corridor
- Duration of construction and pre-commissioning and commissioning activities (34 months).
- Pre-commissioning works (i.e., compressors and pumps for the vessel and pipeline hydrotesting).
- Continuous LNG operational noise sources occurring 24h/day over ~25 years.

Relevant Existing Controls/Mitigations

- Construction: good maintenance of machineries and vehicles, management of Project induced traffic. Employees will be issued with appropriate personal protection equipment (PPE) to reduce their noise exposure to acceptable (i.e., safe) levels.
- Operations: good maintenance of equipment. Noise control measure (i.e., acoustic insulation to ensure sound pressure levels do not exceed 85 dB(A) 1m from the noise source). Sound levels resulting from operations at base load, steady conditions, and off-normal conditions will not exceed legislated limits at the Project boundary. Employees will be issued with appropriate personal protection equipment (PPE) to reduce their noise exposure to acceptable (i.e., safe) levels.
- Decommissioning: maintenance of machineries and vehicles.

The following subsections present the impact evaluation during the three project phases.

8.5.2.3 Impact Assessment

Construction and Commissioning Phase

N1 – Noise emissions from construction activities

During the construction of the LNG facilities, noise emissions will be generated by several machineries and heavy mobile equipment involved in the following different construction activities:

- site preparation and earthmoving: heavy construction vehicles and equipment such as bulldozers, scrapers, front-end loaders, backhoes, graders, rollers, dump trucks and water carts;
- materials offloading: excavators, bulldozers, dump trucks, graders, concrete trucks;
- civil works and plant fabrication: concrete and asphalt batch plants, piling, heavy rollers, dump trucks, concrete trucks, generator sets;
- pipeline construction: bending and welding machines, pipelayer crane;
- access roads construction: excavators, bulldozers, rollers.

Noise levels emitted by construction equipment will range between 85 dB(A) to 100 dB(A) at the source. Highest noise emissions will be limited to the proximity of the equipment, within the Project site boundary. Where noise levels exceed 85 dB, workers will be use Personal Protective Equipment (PPE) to reduce noise levels to comply with national occupational health legislation (see Section 2).

During the pre-commissioning phase, the main source of noise will be the compressors and pumps in use for the vessel and pipeline hydrotesting activities and equipment integrity tests. Noise levels emitted by compressors during pre-commissioning will range between 95 dB(A) to 120 dB(A) at the source. Highest noise emissions will be limited to the proximity of the equipment, within the Project site boundary.

Traffic noise will be generated throughout the construction period. A peak traffic flow of 150 vehicles per day is foreseen, although movements of heavy vehicles (i.e., trucks, dozers, etc.) along the access roads will be for only a limited time and primarily during the day.

Construction activities are expected to last about 34 months including commissioning and pre-commissioning phases. Construction works will be carried out mainly during the daytime, whereas pipeline hydrotesting is expected to operate 24h/day. Not all the construction equipment will be active at the same time in the same area, some of them will in fact operate only during short period and/or in an intermittent frequency. The Project area where construction activities will be carried out is within an Industrial Zone and requires average noise levels to be under 70 dB at all times (day, evening, night) at the Project boundary (see legal requirements in Appendix A). Generally, construction works may generate noise levels above 70 dB LAeq at receptors that are less than 500 m from the worksites.

The nearest receptors (i.e., settlements) are located at a significant distance from the worksites, approximately 2 km far away. The construction activities may increase the existing background noise, especially at receptors located along the access roads or in the proximity of worksites. Therefore, receptors' sensitivity is **medium**.

Considering all the previous aspects, construction activities have the potential to generate direct impacts, local in extent and temporary/short-term in duration. However, the local acoustic climate is already affected by the existing sources of noise (i.e., road traffic, industrial facilities at the Port of Sohar) that result in maximum background noise levels ranging from 63 to 66 dB(A) during the daytime at the nearest settlement of Majis). Construction noise is thus unlikely to be audible above this high background noise and, given the significant distance between construction work sites and settlements (about 2km) it should not exceed the legislated limit for daytime for residential areas (55 dB(A)). Also, in case of potentially construction works occurring at night, construction noise is unlikely to generate significant noise impacts at the nearest settlements (noise limit 45 dB(A) for night-time). Based on the noise monitoring survey performed at Majis community, indeed, high values of background noise levels were monitored also at night (> 60 dB(A)), therefore also at night the noise from construction activities is unlikely to be audible.

Moreover, embedded control measures to reduce noise emissions are already foreseen in Project design (i.e., PPE and standard acoustic enclosure to guarantee 85dB(A) at 1 m from equipment). Therefore, the potential impact to sensitive receptors is **small** magnitude.

According to the impact methodology criteria reported in Section 8.2 the impact significance is **minor**.

Potential impact descriptors for N1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	Medium	**Minor**

Operation and Maintenance phase

N2 – Noise emissions from LNG operations

During the operation phase, the main noise emissions will be generated by the LNG facilities, that include pumps, compressors, generators and their drivers, compressor suction/discharge, recycle piping, air dryers, heaters, air coolers at liquefaction facilities, vaporizers used during regasification.

During loading/unloading operations of LNG carriers/vessels, minimal noise-producing equipment will be operating such as pumps and tanker auxiliary power generators.

Minor noise emissions will be generated from vehicles for personnel's transport, mainly limited at the beginning and finishing of work shifts, and from maintenance operations.

In the event of an operation upset, alarms and emergency flaring will generate significant sound levels, which may temporarily affect the surrounding environment.

It is anticipated that the operational life of the Project will be 25 years and that the LNG plant will run 24 hours a day, 7 days a week. All plant equipment will comply with the best practice in terms of noise emissions management and control (e.g., IFC EHS Guidelines). Special care will be taken with the acoustic insulation, in order to maintain a sound pressure level (SPL) not exceeding 85 dB(A) measured in any position 1 metre from the equipment located in potentially manned areas and not exceeding 90 dB(A) in unmanned areas. In addition, the sound pressure level resulting from the operation of the facility at base load, steady state conditions, including start-up, shut-down, and all other off-normal conditions, will not exceed the regulation limits at any boundary line of the site. Based on the results of a preliminary noise modelling study performed in December 2019[130], the Project is expected to generate noise emission levels equal to 40 dB(A) at a distance of maximum 2-2.5 km from the LNG plant boundary. Although this study provides a reliable assessment of the potential noise contribution of the LNG plant operations to the surrounding environment, it has to be noted that the study was based on a preliminary LNG plant design and the preliminary LNG layout (which has moved very slightly from its original location), potentially subject to changes in plant layout and equipment operations. Therefore a revision of the noise modelling study report is suggested once the final plant layout is defined.

The noise monitoring survey performed in the area (see Section 4) recorded background noise levels ranging between 63 and 66 dB(A) at the nearest settlement of Majis (at a distance of approximately 2 km from the LNG site). At a distance of 2 km the noise contribution of LNG operations is expected to be 40 dB(A), about 20 dB less than the existing background noise. Therefore, the noise from the LNG plant is unlikely to generate a significant increase in the existing background noise.

The nearest receptors (i.e., settlements) are located at a significant distance from the LNG plant, approximately 2 km distant, and ambient noise levels are already affected by existing sources of noise (i.e., road traffic, activities at the Port of Sohar); receptor sensitivity is **medium**.

Considering all the previous aspects, the Project operation phase has the potential to generate direct impacts, local in extent and long-term in duration. However, noise from the LNG Plant is unlikely to be perceived above the existing high background noise. Therefore, the potential impact to sensitive receptors is **small magnitude**.

According to the impact methodology criteria reported in Section 8.2 the impact significance is **minor**.

Potential impact descriptors for N2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Continuous	Local	SMALL	Medium	**Minor**

Decommissioning Phase

N3 – Noise emissions from dismantling equipment

At the end of the operational lifetime of the plant, the LNG facilities and associated infrastructures will be either donated to the Omani Government or decommissioned. Decommissioning will involve the removal and reuse/ recycling/ disposal of surface structures and the reinstatement and restoration of the affected sites. Similar equipment and machineries in use during the construction phase will operate, therefore noise emissions from decommissioning activities will be comparable, or even lower, than noise generated during construction.

Decommissioning activities have the potential to generate direct impacts, local in extent (usually confined within 500 m) and temporary in duration. Therefore, the potential impact to sensitive receptors is **small** magnitude.

[130] Noise Study Report for Sohar LNG Bunkering. JGC - Total, December 2019 (Doc. Ref. *OM-SOH-00-TEC1-410003*).

The nearest receptors (i.e., settlements) are located at a significant distance from the plant site, approximately 2 km. The decommissioning activities may increase the existing background noise, especially at receptors located along the access roads or in the proximity of worksites. Therefore, receptors' sensitivity is **medium**.

Considering all the previous aspects, the impact significance during decommissioning is **minor**.

Potential impact descriptors for N3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	Medium	**Minor**

8.5.2.4 Mitigation measures

Construction and Commissioning phase

During construction, a Traffic Management Plan will be developed and implemented to minimise as far as practicable the induced traffic noise generated by the transit of heavy vehicles, in particular through the reduction of vehicles' speed when crossing inhabited areas and the provision of employee awareness training, if needed.

The following best practice procedures will be implemented during the construction to reduce impacts on the acoustic climate:

- select available equipment and vehicles that optimise noise reduction;
- switch off equipment when not in use;
- limit (as far as practicable) the operation of non-routine high noise generating equipment during the holidays and night time;
- locate stationary equipment (i.e., generators) as far as practicable from nearby receptors;
- implement a Traffic Management Plan to minimise as far as practicable the induced traffic noise generated by the transit of heavy vehicles, in particular through the reduction of vehicles' speed when crossing inhabited areas and the provision of employee awareness training, if needed;
- an appropriate Vehicles and Equipment Maintenance Programme will be developed and implemented throughout the construction phase; and
- noise will be monitored during the construction phase (including in sensitive receptors such as Majis village); monitoring will provide an extended profile of ambient noise at the project boundary and at receptors.

Operation and Maintenance Phase

In addition to the embedded noise control measures implemented by the Project (i.e. standard acoustic enclosure to guarantee 85dB(A) at 1 m from equipment), the following best practice procedures will be implemented during the operation phase to reduce impacts on the acoustic climate:

- selection of equipment according to the best technologies available in terms of noise reduction;
- an appropriate Vehicles and Equipment Maintenance Programme will be developed and implemented throughout the operation phase; and
- noise will be monitored during the operation phase (including in sensitive receptors such as Majis village); monitoring will provide an extended profile of ambient noise at the project boundary and at receptors.

Decommissioning Phase

The same mitigation measures considered for the construction phase will be implemented during the decommissioning phase.

Residual impacts

Considering the distance to sensitive receptors (~ 2 km) and the implementation of the above-mentioned mitigation measures and Project controls, the residual impact significance on acoustic climate from construction, operation and decommissioning of the LNG plant and associated facilities will be of **minor** significance.

However, it is recommended to:

- Carry out noise monitoring during construction, operation and decommissioning (including in sensitive receptors such as Majis village) to ensure that the noise is in line with National Environmental Emissions Guideline limits. In addition, the noise monitoring conducted during the construction phase will provide an extended profile of ambient noise at the project boundary and at receptors. More information on monitoring for the Project is provided in Section 9.7 under the respective monitoring program;
- Revise the noise modelling study for LNG operation phase once the final Project design is defined.

Residual impact descriptors for Construction and Decommissioning Phases						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	Medium	**Minor**
Residual impact descriptors for Operation Phase						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Long-term	Continuous	Local	SMALL	Medium	**Minor**

8.5.3 Soils

8.5.3.1 Impact Identification

Table 8-19 presents the key potential impacts of the Project on soil quality. Further detailed assessment is carried out in the next subsections.

Table 8-19 Key Potential Impacts – Soils

Construction and Commissioning phase	Operation phase	Decommissioning phase
S1 – Soil degradation and contamination during construction works	S2 – Soil contamination during the operations.	S3 – Soil degradation and contamination during decommissioning.

8.5.3.2 Key Considerations

Box 8-4 presents the key sources of impacts, baseline, and project factors influencing the impact and relevant existing Project controls/mitigation embedded measures.

Box 8-4 Key Considerations for Assessment – Soils

Sources of Impact

- Construction: pipeline and power transmission line construction. Generation of hazardous and non-hazardous waste, and minor leaks and spills.
- Operations: Generation of hazardous and non-hazardous waste, operation of LNG equipment, operation of worker camps, and minor leaks and spills.
- Decommissioning: Generation of hazardous and non-hazardous waste, removal of pipelines and existing structures, as well as chemical storage and laydown area.

Particular Baseline Conditions that Potentially Influence Impacts

- Project will be located on reclaimed land prepared by an SIPC contractor.
- Reclaimed land has been prepared by an SIPC contractor and is compacted and barren.
- Project area has occasional heavy rainfall from tropical cyclone storms.

Project Factors that Potentially Influence Impacts

- Construction period is ~34 months.
- On-site soil improvement and pilling (i.e., standard pilling and shallow foundation construction).

Relevant existing Controls/Mitigations

- An Oil Spill Contingency Plan (OSCP) will be developed in accordance with MARSA LNG LLC standard GM EP ENV 092 to appropriately manage spills during all phases of the Project. The plan will include typical industry standard spill management (e.g., drip pans and dedicated work areas) where appropriate and all waste will be appropriately contained before removal to licensed waste facilities.
- Significant soil dumping is not likely and will only occur if approved by the relevant authority.
- Topsoil stockpile (containing seeds) will be < 2 m and preserved to prevent degradation.
- Appropriate hazardous materials and waste management
- Appropriate wastewater management and disposal
- Management of storm water generated with the battery limit

The following subsections present the impact evaluation during the three project phases.

8.5.3.3 Impact Assessment

8.5.3.3.1 Construction and Commissioning phase

8.5.3.3.2 S1 - Soil degradation and contamination during construction works

Soil is regionally described in detail in Section 4 and is likely to characterise the reclaimed land that has been prepared by SIPC, given that material has been sourced by SIPC from material from excavated during capital dredging of the port basin. The reclaimed site is compacted and barren with no soil horizons or organic content.

On-site land improvements (i.e., standard pilling and shallow foundation construction) may be necessary depending on the quality of the existing reclaimed land. However, the soil improvement will be used only in limited way, only in areas where higher loads and equipment will be installed. If required, the aggregates needed will be supplied from existing local borrow pits or quarries and that the volume required is considered as negligible. Soil improvements are likely to have a negligible impact as reclaimed soil is highly modified (i.e., soil has little to no environmental value).

As reclaimed land has been prepared for the sole purpose of industrial activity, human receptors are expected to be negligible, impact magnitude is small, and physical receptor sensitivity is low. While soil associated with the transmission line and both pipelines are outside of the reclaimed area, their corridor routes have been extensively disturbed and modified by the installation of existing industrial pipelines within the Sohar Port Area and has little value with regard to cultivation of crops or natural vegetation. Nevertheless, surface soil (containing seeds) will be stockpiled and later returned to the surface of the pipeline corridor to facilitate later vegetation (e.g., grass) growth where possible. Soil impacts associated with the pipeline will be accordingly small and low with respect to magnitude and sensitivity, with an overall **negligible** significance**.**

During construction activities, the main types of wastes expected to be produced include inert construction waste, domestic waste as well as oily and hazardous waste. All wastes from work areas and from the Temporary Site Facilities, if any, will be placed in the nearest appropriate covered waste containers and these are collected. All hazardous wastes generated will be stored in a secure and clearly identified compound for subsequent disposal in an approved disposal site. The wastewater produced will be collected into a septic tank for later disposal by an authorized company. Oily/greasy water will not be directed into the septic tank until the oil and grease have been removed. Hydrotest water, used to ensure the integrity of vessels, tanks and piping by raw water, will be reused in the hydrotesting of different parts of the project. Once Hydrotesting is completed, the water will be contained for analysis. If the water is compliant with relevant standards (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port to the MISC industrial waste water treatment facility.

The construction activities will involve the use of hazardous materials (e.g., fuels, oils and solvents for the movement and maintenance of vehicles and equipment). Any spill of fuel, oil or chemicals could potentially affect the soil beneath the spill site by infiltration if not dealt with in an appropriate and efficient manner.

Potential soil degradation and contamination impacts are therefore expected to be minimal in scale, short-term, and of overall small magnitude. The impact extent will be limited to the Project footprint and the sensitivity of the receptor is low. Overall impact significance is accordingly **negligible.**

Potential impact descriptors for S1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

Operation and Maintenance Phase

S2 - Soil contamination during operation and maintenance phase

Various hazardous chemicals will be utilized in the LNG process (e.g., methyl diethanolamine, antifoam, corrosion inhibitor, and lubrication oil for equipment maintenance) and stored in large quantities on site over the long term (>30 years) in conjunction with effluent (e.g., contaminated liquid in drip pans and site runoff; described under operational effluent management in section 3.7.11). Non-hazardous wastes will typically include miscellaneous office rubbish such as paper and food. Within the reclaimed area, soil can become contaminated from occasional leaking or spilt lube oils and greases from machines (e.g., pumps, transformers, etc.), waste water from bunded areas including roof of oil/condensate storage tanks, and chemicals.

Storm water and wastewater collection systems will be installed across the site. All waste will be collected, stored, and segregated appropriately within bunded areas to avoid contamination of soil (See existing controls in Box 8.4). Wastewater treatment will be ensured by an external party operating in Sohar Port. Wastewater (clean process and drain water) will be gathered at the plant to be exported to the external treatment unit, no wastewater pre-treatment at site is foreseen. Effluents discharges will comply with local legislation and requirements.

The extent of the impact will typically be limited to the Project site (i.e., reclaimed land) and is unlikely to affect other potential receptors (e.g., birds, employees, and neighbouring industries). The magnitude and sensitivity of the impact is viewed as small and low respectively, with a **negligible** overall significance.

Potential impact descriptors for S2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

8.5.3.3.3 Decommissioning Phase

8.5.3.3.4 S3 – Soil degradation and contamination during decommissioning.

Heavy machinery and equipment used during the decommissioning phase will be comparable to that deployed during the construction phase (discussed above). However, the volume of hazardous and non-hazardous material on site is likely to be greater. As in other phases, this material will be appropriately segregated, contained, treated and removed as the current operator will need to return the Project site (including both pipeline corridors) to its pre-development condition (i.e., condition provided by SIPC and verified through a zero soil analysis).

Potential soil degradation and contamination impacts are therefore expected to be minimal in scale, short-term, and of overall small magnitude. The impact extent will be limited to the Project footprint and the sensitivity of the receptor is low. Overall impact significance is accordingly **negligible.**

Potential impact descriptors for S3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

8.5.3.4 Mitigation measures

Mitigation methods will vary for all phases. Recommended mitigation measures for potential soil impacts are as follows:

8.5.3.4.1 General mitigation methods

- Through the implementation of the Waste Management Plan, appropriate storage, transportation, and disposal of non-hazardous and hazardous waste generated during all phases; and
- Excavation of contaminated soil, and immediate storage and appropriate disposal as hazardous waste.
- Immediately notify the operations team / control room of any leaks and spills as per the Emergency Response Plan.

8.5.3.4.2 Construction and Commissioning phase

- Prior to the commencement of construction, a zero-soil survey to SIPC standards (Version 1.2, March 6, 2014) will be conducted with the purpose to determine the soil quality of the reclaimed land (collecting and analysing metals and trace elements, TPH, aromatics, and PAH) and to have reference composition prior to a tenant's development of the site.
- Regular maintenance of all heavy machinery and vehicles to avoid leak spills as part of a Vehicles and Equipment Maintenance Programme.
- Through the implementation of the OSCP, provision secondary containment (i.e. drip trays and spill kits) for heavy machinery and vehicles on site.

8.5.3.4.3 Operation Phase

- Regular maintenance of operational equipment in LNG train as part of a Vehicles and Equipment Maintenance Programme.
- Providing secondary containment for operational equipment (i.e., pumps, compressors, emergency generators etc.);and for diesel storage, chemical storage and hazardous waste storage.
- Appropriate waste and wastewater management to avoid spillage and minimise soil pollution.
- Development of an Emergency Response Plan which should be actioned in the event of leaks and spills.

8.5.3.4.4 Decommissioning Phase

- Regular maintenance of all heavy machinery and vehicles to avoid leak spills as part of a Vehicles and Equipment Maintenance Programme.
- Providing secondary containment (i.e., drip trays and spill kits) for heavy machinery, vehicles on site, fuel storage areas, chemicals storage areas and hazardous waste storage areas;
- Manage waste and wastewater adequatey to avoid spillage and minimise soil pollution; and

- Conducting a zero-soil survey (as per SIPC standards) at the end of the decommissioning phase to assess difference in potential contamination levels in the soil compared to the zero-soil survey carried out prior to the commencement of construction

8.5.3.5 Residual impacts

As the potential impact is **negligible** for all phases considering the short-time frame and existing control measures in place; additional mitigation reduced the frequency of the impact but does not affect the overall impact significance. However, despite the negligible significance of the project impacts to soils, regular audits and inspections are required to ensure that appropriate controls (i.e., secondary containment) are in place and no potential leaks and spills are undetected.

Residual impact descriptors for S1, S2 and S3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	SMALL	LOW	**Negligible**

8.5.4 Groundwater (GW)

8.5.4.1 Impact Identification

Table 8-20 presents the key potential Project impacts on ground water. Further detailed assessment is carried out in the next subsections.

Table 8-20 Key Potential Impacts – Groundwater

, Construction and Commissioning phase	Operation phase	Decommissioning phase
GW1 – Groundwater degradation and diversion from excavation and spillage of hazardous material during construction.	GW2 – Groundwater degradation from operational hazardous material spills.	GW3 – Groundwater degradation and diversion from excavation and spillage of hazardous material during decommissioning.

8.5.4.2 Key Considerations

Box 8-5 presents the key sources of impacts, baseline, and project factors influencing the impact and relevant existing Project controls/mitigation embedded measures.

Box 8-5 Key Considerations for Assessment – Groundwater

Sources of Impact

- Construction: Trench excavation and spillage of hazardous material from vehicles and machinery.
- Operations: spillage of hazardous material.
- Decommissioning: Trench excavation and spillage of hazardous material from vehicles and machinery.

Particular Baseline Conditions that Potentially Influence Impacts

- Groundwater ranges from sea-level to ~8 mbg along the both pipelines and transmission corridors;
- Project area has occasional heavy rainfall from tropical cyclone storms.
- Runoff flow is generally in the north-west direction within SIPC;
- Existing groundwater sources are overexploited;
- Pipeline soil type is susceptible to flash flooding;
- Flooding within SIPC is typically well managed.

Project Factors that Potentially Influence Impacts

- The length of the power transmission line is ~3.5 km and will be buried.
- The condensate pipeline (~50 m) may be buried (around ~10 m length) and the rest will be installed above ground.
- No groundwater sources are required. During construction, potable water will be probably supplied by the Majis Industrial Services or an external party in the port at a rate of ~150 m^3/day (60 litres/day per person). For the operation phase, process and potable water will be supplied by Majis Industrial Services, which is fed with water from a desalination plant. Potable water during operation will be supplied at a rate of 25 m^3/day (on the basis of 120 people on site consuming on average 200 litres/day per person).
- On the other hand, only in case it is strictly necessary for the potential burial of the condensate pipeline (~10 m long), after the corresponding geotechnical studies at the site, the section may be dewatered.
- Storage and handling of hazardous materials will be within sealed bunded areas.

Relevant existing Controls/Mitigations (similarl to soil quality controls listed above)

- Construction & decommissioning: Hydrotest water will be reused. Once hydrotesting is completed, the water will be contained for analysis. If the water is compliant with relevant standards (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port.
- Operations: Contaminated runoff (and wastewater) will be collected on site and disposed at the external water treatment plant as hazardous waste by an external party. No wastewater pre-treatment at site is foreseen.
- An oil spill contingency plan will be developed in accordance with MARSA LNG LLC standard GM EP ENV 092 to appropriately manage spills during all phases of the Project.
- Appropriate hazardous materials and waste management
- Appropriate wastewater management and disposal
- Dewatering fluids will be handled and if necessary, treated before discharge. Monitoring of the quality of groundwater abstracted during dewatering will be carried out.

8.5.4.3 Impact Assessment

8.5.4.3.1 All Project phases

8.5.4.3.2 **GSW1-3 – Groundwater degradation and diversion from excavation and spillage of hazardous material**

Excavation of the power transmission line and the condensate pipeline during construction and decommissioning phases may temporarily expose groundwater to contaminated runoff from existing industries and can alter the direction of flow through short-term canalisation (i.e., open trenching). Contamination of groundwater could pollute the quality of local irrigation water resources in the vicinity of the Project. However, considering the direction of groundwater flows towards the sea, these sources are at low risk. On the other hand, the quality of marine water could be reduced where it finds its way to the sea, though it is low likelihood. Groundwater diversion can reduce potable water resources or potentially mobilise historic soil contamination (i.e., previously outside normal flow paths). Hazardous material spills can include leaking oil and/or hydraulic fluid from vehicles and machinery.

Local groundwater will not be extracted by the Project since during construction, potable water will be probably supplied by Majis Industrial Services or by a 3rd party, and during operation, potable water and process water will be sourced from Majis Industrial Services, which is fed with water from a desalination plant. On the other hand, only in case it is strictly necessary for the potential burial of the condensate pipeline (~10 m long), after the corresponding geotechnical studies at the site, the section may be dewatered. Dewatering fluids will be handled and if necessary, treated before discharge. Monitoring of the quality of groundwater abstracted during dewatering will be carried out.

All wastewater (including runoff) will be collected and treated (if necessary) before disposal by an appropriate authorised company. Hydrotest water for the LNG tank will be sourced from the marine environment and hydrotest water produced during the precommissioning and commissioning phases will be reused in the hydrotesting of different parts of the project. Once Hydrotesting is completed, the water will be contained for analysis. If the water is compliant with relevant standards (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port.

Potentially contaminated water will be collected in a dedicated storm water basin and first flush will be sent to the external water treatment plant. Non-contaminated water will be collected and discharged to the SIPC reclaimed land drainage channel in compliance with the applicable limits.

Both groundwater degradation and diversion are highly unlikely during all Project phases as the power transmission line and the condensate pipeline will follow existing corridors above the typical groundwater level (i.e. < 8m bgl). In conjunction, hazardous material spills will be temporary, highly localised, and managed by a spill contingency plan in accordance with MARSA LNG LLC standard GM EP ENV 092 during all phases of the Project.

Impact magnitude and receptor sensitivity is accordingly negligible and low respectively, and overall impact significance is **negligible**.

Impact descriptors for GW1, GW2 and GW3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Short-term	Rare	Local	NEGLIGIBLE	LOW	**Negligible**

8.5.4.4 Mitigation measures

Apart from the project embedded controls/mitigations that will be put in place, the recommended mitigation measures for groundwater related impacts are as follows:

8.5.4.4.1 Construction and Decommissioning phases

In order to limit potential groundwater exposure and diversion, pipeline and transmission line excavation should be done in sections. The length of the exposed trench segments will be established (during the risk assessment) before opening the trenches. Trenches will be filled-in before the next section is started.

On the other hand, only in case it is strictly necessary for the potential burial of the condensate pipeline (~10 m long), after the corresponding geotechnical studies at the site, the section may be dewatered. Dewatering fluids will be handled and if necessary, treated before discharge. Monitoring of the quality of groundwater abstracted during dewatering will be carried out.

Given that any spills will be managed by a spill contingency plan in accordance with MARSA LNG LLC standard GM EP ENV 092 during all phases of the Project, no further mitigation measures are deemed necessary for operations.

8.5.4.5 Residual impacts

Residual impacts are anticipated to remain of **negligible** overall significance but should be temporary (< 1 week) rather than short-term (1-8 weeks) following the implementation of mitigation described above.

Residual impact descriptors for GW1, GW2 and GW3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	NEGLIGIBLE	LOW	**Negligible**

8.5.5 Surface Water (SW)

While adjacent to the sea, no permanent surface water resources (e.g., rivers, lakes, or dams) are associated with the Project and potential surface water impacts are associated with storm water runoff to the ocean only; from outside the reclaimed area along the Condensate export pipeline (~50m), and the power transmission line (3.5km).

8.5.5.1 Impact Identification

Table 8-21 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Table 8-21 Key Potential Impacts –Surface Water

Construction and Commissioning phase	Operation phase	Decommissioning phase
SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction.	SW2 – Contamination of storm water runoff from waste and hazardous material spills.	SW3 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during decommissioning.

8.5.5.2 Key Considerations

Box 8-6 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-6 Key Considerations for Assessment – Surface water

Sources of Impact

- Construction: storm water runoff in areas of excavation, grading, laydown, and chemical storage areas.
- Operations: storm water runoff from contaminated surfaces within the Project site.
- Decommissioning: storm water runoff in areas of excavation, grading, laydown, and chemical storage areas.

Particular Baseline Conditions that Potentially Influence Impacts

- Runoff flow is generally in the north-west direction;
- Project area has occasional heavy rainfall from tropical cyclone storms;
- Soil associated with pipelines typically has low porosity and is susceptible to flash flooding;
- Flooding within SIPC is typically well managed; and
- Project site is on reclaimed land has already been prepared by SIPC (under a separate project).

Project Factors that Potentially Influence Impacts

- Hazardous materials will be bunded and will not be susceptible to runoff events.
- Potentially contaminated Project runoff will be collected and treated (if necessary) before being discharged by a third party.
- Stockpiled material will be stored so as not to block typical north-west surface flow.

Relevant existing Controls/Mitigations (similarly to soil quality above)

- Construction & decommissioning: Hydrotest water will be reused and then disposed of by an authorized company operating in the Sohar Port or discharged to the sea. If hydrotest water disposal into the sea is the selected method chosen, it will fully meet Omani environmental standards and legislation.
- Operations: Contaminated runoff, first flush from storm water basin and wastewater will be collected on site and disposed at the external water treatment plant as hazardous waste by an external party. No wastewater pre-treatment at site is foreseen.
- An oil spill contingency plan will be developed in accordance with MARSA LNG LLC standard GM EP ENV 092 to appropriately manage spills during all phases of the Project.
- Appropriate hazardous materials and waste management
- Appropriate wastewater management and disposal

The following subsections present the impact evaluation during the three project phases.

8.5.5.3 Impact Assessment

Construction and Commissioning phase

SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction.

During construction, stormwater runoff (caused by rare high rainfall events) typically drains along the surface in a north-west direction towards the sea. Direct disruption (e.g., diversion or accumulation) as well as contamination of storm water runoff can occur in areas where the Project alters natural gradients and generates pollution, such as in areas of Project excavation and hazardous chemical handling/ storage. While marginal, vehicle and machinery leaks of oil and hydraulic fluid (hazardous material) can also contribute to the contamination of these areas.

Runoff flow paths within the reclaimed area will be designed by SIPC and will be maintained (i.e., not disturbed) during Project construction. Handling and storage of Project chemicals and waste will be typically undertaken in the reclaimed area within bunds that will contain runoff.

Storm water runoff within the excavation corridors for the power transmission line as well as the Condensate pipeline may be disrupted in the short-term. The stockpiled material will be stored so as not to block north-west surface flow and the excavated corridor route design avoid established surface channels as far as possible. Stockpiles will be <2 m to reduce erosion into the storm water system.

Hydrotest water will not be freely discharged but instead re-used for all tanks. Once hydrotesting is completed, the water will be contained for analysis. If the water is compliant with relevant standards (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. I If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port to the MISC industrial waste water treatment plant within the Sohar Port Industrial area.

Other waste streams that can potentially contaminate surface waters will also be treated and managed using an SIPC approved external party. Sewage water will be treated through a septic tank on site.

Impact magnitude is accordingly small with low sensitivity given that runoff events are rare and will discharge to the industrial port that is considered to be not sensitive. Overall, the impact is infrequent, short-term, localised in extent, and likely to have a **negligible** significance.

Potential impact descriptors for SW1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	SMALL	LOW	**Negligible**

Operation and Maintenance Phase

SW2 – Contamination of storm water runoff from waste and hazardous material spills during operation.

As previously described (Section 3.7.11), storm water runoff within the reclaimed area can become contaminated from leaking or spilt lube oils and greases from machines (e.g. pumps, transformers, etc.), waste water from bunded areas including roof of oil/condensate storage tanks, chemicals. The potential contamination of storm water runoff during operation is expected to have a small magnitude as potential surface contaminants will be limited through regular cleaning. Contaminants (including firefighting chemicals) that are mixed with runoff water will be collected in a dedicated bund (technically called lift station as per Figure 3-9). First flush runoff water from potentially contaminated area will be treated by a third party external water treatment plant and after first flush, the remaining runoff water will only be discharged to the sea if it meets discharge water quality limits (MD 159/2005).

Appropriate containment and disposal measures will minimize the likelihood of storm water runoff contamination. Despite the long-term nature of potentially contaminating activities, receptor sensitivity will be low considering appropriate containment and disposal measures that will take place and the nature of the reclaimed land; with the exception of unplanned events associated with large volumes of chemicals. Consequently, the significance of the impact under normal conditions is estimated to be **negligible.**

Various hazardous chemicals will be utilized in the LNG process (e.g., methyl diethanolamine, antifoam, corrosion inhibitor, and lubrication oil for equipment maintenance) and stored in large quantities on site over the long term (>25 years) in conjunction with produced water and potentially contaminated site runoff. Non-hazardous wastes will typically include miscellaneous office rubbish such as paper and food. All waste will be collected, stored, and segregated appropriately within bunded areas to avoid contamination of soil (See existing controls in Box 8.6). Hazardous liquids will similarly be contained and treated at an external water treatment plant.

The extent of the impact will typically be limited to the Project site and is unlikely to affect other potential receptors (e.g. birds, employees, and neighbouring industries). The magnitude and sensitivity of the impact is viewed as small and low respectively, with a **negligible** overall significance.

Potential impact descriptors for SW2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	SMALL	LOW	**Negligible**

Decommissioning Phase

SW3 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during decommissioning.

Potential disruption and contamination of storm water runoff during decommissioning is expected to be similar to the construction phase whereby established runoff pathways can be changed and polluted following earth works and associated materials storage. As with construction, soil will be stockpiled to avoid blocking north-west surface flow and excavation will be staggered to minimise exposed (e.g., excavated) areas. The waste hierarchy will be applied whereby the generation of rubble and other wastes will be avoided as far as possible (e.g., through reuse of buildings/refurbishment), and thereafter recycled (as far as practicable) and disposed of in terms of the waste hierarchy. Impact magnitude is thus expected to be small.

Receptor sensitivity is similarly low as the disruption and contamination of storm water runoff will occur on industrialised sites that are not anticipated to be associated with other sensitive receptors. The potential impact will also occur during a relatively short-time frame and the overall impact significance is **negligible.**

Potential impact descriptors for SW3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	SMALL	LOW	**Negligible**

8.5.5.4 Mitigation measures

Mitigation methods will vary for all phases. Recommended mitigation measures for storm water runoff related impacts are as follows:

General mitigation methods

- Through the implementation of the Waste Management Plan, appropriate storage, transportation, and disposal of non-hazardous and hazardous waste generated during all phases.
- Immediate excavation of contaminated soil and storage as hazardous waste.
- Immediately notify the operations team/ control room of any leaks and spills as per the Emergency Response Plan.

Construction and Commissioning phase

- Regular maintenance (as per manufacturers recommendations) of all heavy machinery and vehicles to avoid leak and spills as part of a Vehicles and Equipment Maintenance Programme.
- Through the implementation of the OSCP, providing secondary containment (i.e., drip trays and spill kits) heavy machinery, hazardous and chemical storage areas.
- Ensure appropriate clearance and disposal of hazardous waste and chemicals in storage areas. Any spills to be reported and mitigated as per the Emergency Response Plan.

Operation and Maintenance Phase

- Regular maintenance of operational equipment in LNG train.
- Providing secondary containment for operational equipment (i.e., pumps, compressors), diesel storage, hazardous waste storage and chemical storage areas.
- Manage waste and wastewater adequately in order to avoid spillage and minimise soil pollution.
- Ensure storm water in potentially polluted areas is appropriately collected and channelled into the storm water drainage system.
- Test and treat collected runoff (if necessary) to ensure compliance with national and international standards before discharge.

Decommissioning Phase

- As per construction mitigation measures.

8.5.5.5 Residual impacts

As the potential impact is **negligible** for all phases, additional mitigation does not affect the overall impact significance.

Residual impact descriptors for SW1, SW2 and SW3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	SMALL	LOW	**Negligible**

8.5.6 Landscape and visual (LF)

As indicated in the baseline Section 4.1.8 and Section 5.1.5; conspicuous features of the Sohar port correspond to the large cranes located throughout the port in addition to the existing industrial infrastructure such as the oil refinery, tank farm, flare stacks and Liwa plastics petrochemical complex; which in conjunction to being located within a largely “flat” landform (e.g. coastal plain), the presence of man-made structures are visible from a distance. Although the LNG plant is located between the Majis jetty and the southern breakwater of the port; no significant reduction of landscape aesthetic or character is foreseen.

8.5.6.1 Impact Identification

Table 8-22 presents the key potential impacts of the Project on landscape and visual aesthetics. Further detailed assessment is carried out in the next subsections.

Table 8-22 Key Potential Impacts – Landscape & Visual

Construction and Commissioning phase	Operation phase	Decommissioning phase
LF1 – Reduced landscape aesthetic from material laydown area and dust generation during construction.	LF2– Reduced landscape aesthetic	LF3 – Reduced landscape aesthetic from material laydown area and dust generation during decommissioning.

8.5.6.2 Key Considerations

Box 8-7 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Box 8-7 Key Considerations for Assessment – Landscape and Visual

Sources of Impact

- Construction & decommissioning: Erection of temporary structures, construction of access roads and pipelines, poor waste management, construction laydown area.
- Operations: Operation of jetty, generation of hazardous and non-hazardous waste, shipping activity, operation of combustion equipment (i.e., Flare, incinerator, generator), laydown area.
- Decommissioning: Hazardous and non-hazardous waste generation, removal of temporary structures, demolishing of structures.

Particular Baseline Conditions that Potentially Influence Impacts

- Permanent visual receptors include the Majis community, Maritime College, and SIPC workforce (~2km, 1.5km, and 500m from the Project site respectively) and fishermen.
- Project site is within the SIP (i.e., zoned for industrial development) and is currently characterised by beachfront and open ocean.
- The Project site will be located on new flat reclaimed land (developed and prepared by SIPC) with no visually appealing characteristics (apart from open ground and a sea wall).
- Future industrial developments (similar to the Project) will be developed adjacent to the Project in within the larger SIP industrial zone.
- Sense of place is already characterised by industrial activity.

Project Factors that Potentially Influence Impacts

- Construction period is estimated to be ~34 months.
- Project will include visually unappealing stack infrastructure and flaring activity only during start up, shut down and in emergency situation. The plant is designed as a zero-flaring plant, where all the normal flaring base line emitters have been eliminated at the design stage.

Relevant existing Controls/Mitigations

- Construction & decommissioning: laydown areas will be kept clean and tidy and dust will be managed through wet suppression.
- Operations: Visual impacts related to flaring will be temporary and will only occur during start-up, emergency, and shut down.

The following subsections present the impact evaluation during the three project phases.

8.5.6.3 Impact Assessment

Construction and Commissioning phase

LF1 – Reduced landscape aesthetic from material laydown area and dust generation during construction.

While the Project site was originally characterised as beach front and open sea, it has now been transformed by SIPC to be new reclaimed land and is flat and barren with no visually valued characteristics (apart from open ground and a sea wall).

Visually unappealing construction activities such as excavation, erection of structures, dust generation, and laydown of materials may temporarily reduce the site's overall visual appearance however the impact is anticipated to have a small and highly localised magnitude in the context of its location in the greater SIP industrial zone.

Visual impacts associated with construction are comparable to past visual impacts and are expected to be localised to the nearby maritime college in Majis and SIP workforce, while the community at the Majis settlement will likely be able to view the Project towards the end of its construction only. Local illegal fishermen are accustomed to industrial activity. Receptor sensitivity is accordingly considered to be low and overall impact significance is likely to be **negligible**.

Potential impact descriptors for LF1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	30 months	Local	SMALL	LOW	**Negligible**

Operation and Maintenance Phase

LF2 – Reduced landscape aesthetic

Despite the heavily industrialized nature of the port, the potential impact magnitude to sensitive receptors is medium due to additional visual impact caused by the operation of the jetty, vessel activity and flaring events only planned during start-up, shut down, and emergency situations. The plant is designed as a zero-flaring plant, where all the normal flaring that would have occurred in the base have been eliminated at the design stage.

As indicated in the Project description (Section 3.7.7.2), only the tips of the warm flares will be active (i.e. lit) during normal operations to ensure ignition when needed. Light from the flare tips can be a continuous long-term impact but is anticipated to be comparable to low powered electric lights on the facility at night. The LNG facility will have large structures that will typically be visually unattractive to the nearby Majis settlement.

Unplanned flaring events during emergency shut down is likely during the operational phase of the plant which will be visible to road users and neighbouring local inhabitants within 10 km (i.e., Harmul, Ghadfan, Majis etc). However, visual impacts due to flaring during unplanned/non-routine events will occur infrequently. Receptor sensitivity is likely to be low considering flaring is already occurring in the SIP area. Consequently, the overall significance of the impact is **minor.**

Potential impact descriptors for LF2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	25 years	Local	MEDIUM	LOW	**Minor**

Decommissioning Phase

LF3 – Reduced landscape aesthetic from material laydown area and dust generation during decommissioning.

Material laydown and dust generation during decommissioning can be unattractive and reduce the aesthetic value of a landscape. The Project site is however associated with heavy industry and is not expected to have significant aesthetic value, particularly once neighbouring industrial activity is established. Decommissioning will be temporary (short term) and will be managed to minimise dust generation (e.g., through wet suppression) and unattractive stockpiles of equipment and material (e.g., though segregation, low lying and neat stockpiles, and timely removal). Impacts are therefore likely to be temporary and localised with an overall small magnitude. While receptors are likely to change over the life of the Project, they should be accustomed to typical industrial activities (including decommissioning) and sensitivity is expected to remain low**.** Consequently, the overall significance of this impact is **negligible**.

Potential impact descriptors for LF3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	One-off	Local	SMALL	LOW	**Negligible**

8.5.6.4 Mitigation measures

Mitigation methods will vary for all phases. Recommended mitigation measures for potential landscape and visual aesthetics impacts are as follows:

General mitigation methods

- Appropriate storage and disposal of non-hazardous and hazardous waste.

Construction and Commissioning phase

- Installation of fencing and barriers during construction to minimize visual impacts to nearby receptors;
- Organized (neat and tidy) storage of all construction material and chemicals in laydown areas; and
- Regular dust suppression.

Operational phase

- Given that mitigation measures were embedded in the design of the plant, which is designed as a zero-flaring plant, no additional mitigation measures are deemed to be necessary.

Decommissioning Phase

- As per construction mitigation measures.

8.5.6.5 Residual impacts

As the potential impact is **negligible** for construction and decommissioning phases; additional mitigation does not affect the overall impact significance. During operation, impacts from the jetty operations and temporary flaring events occurring only during start up, shut down and emergency situation are considered **minor** within the context of the industrialised SIP with established industry. Despite the implementation of recommended mitigation measures, the jetty operations and vessel activity will remain and therefore prior notice to nearby communities and the implementation of a grievance mechanism throughout operations is required to address associated impacts appropriately.

Residual impact descriptors for LF1 and LF3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	30 months	Local	SMALL	LOW	**Negligible**

Residual impact descriptors for LF2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	25 years	Local	MEDIUM	LOW	**Minor**

8.5.7 Terrestrial Ecology and Habitats (THE)

8.5.7.1 Impact Identification

Table 8-23 lists the key potential impacts of the Project on Terrestrial Ecology and Habitats. Further detailed assessment is carried out in the next subsections.

Table 8-23 Key Potential Impacts – Terrestrial Ecology & Habitats

Construction and Commissioning phase	Operation phase	Decommissioning phase
THE1- Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material during construction.	THE2 - Disruption to terrestrial ecology and habitat from waste, noise and air emissions, and flaring during operation.	THE3 - Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material decommissioning.

8.5.7.2 Key Considerations

Box 8-8 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Box 8-8 Key Considerations for Assessment – Terrestrial Ecology & Habitats

Sources of Impact

- Construction: Vehicles and machines, temporary labour camps, and work areas.
- Operations: LNG facilities, workers camps, incineration, and flaring.
- Decommissioning: Vehicles and machines, temporary labour camps, and work areas.

Particular Baseline Conditions that Potentially Influence Impacts

- Reclaimed land is barren surrounded by industries (Sohar Port Industrial Area).
- Birds near the Project site.
- Project is within the Al Batinah Coast IBA. There are other IBAs not overlapped by the Project site, such as the Khawr Shinas and Khawr Liwa IBA located 5 km and 20 km away, respectively, and the Sun Farms IBA, located 22 km away.

Project Factors that Potentially Influence Impacts

- All land used directly by the Project will be located inside the LNG site or existing corridors (with regard to pipelines and transmission lines).
- Construction, pre-commissioning and commissioning and operational periods are ~34 months and 25 years respectively.

Relevant existing Controls/Mitigations

- Construction & decommissioning: Appropriate waste management and handling procedures
- Operations: Appropriate waste management and handling procedures; minimise lighting levels; installation of bird deterrent-reflectors to be considered near infrastructure that may attract or harm birds (e.g., flare and waste storage); engagement with SIPC for the establishment of a Biodiversity Management Plan including a bird monitoring program to assess the effect of flaring, though engagement with SIPC and other industries carrying out flaring in the SIP area.

The following subsections present the impact evaluation during the three project phases.

8.5.7.3 Impact Assessment

Construction and Commissioning phase

THE1- Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material during construction

As outlined in the Project Description and Terrestrial Baseline Sections (i.e. Sections 3 and 4), the Project site will be constructed on reclaimed (unvegetated) land, zoned for industrial use which is unlikely to support significant ecology (e.g. endemic or IUCN red data species). No endangered flora and fauna species are found in the immediate area. While within SIPC, the Project site is also within the Al Batinah IBA, and near the Khawr Shinas and Khawr Liwa IBAs (Figure 4.23). Potential impacts on terrestrial ecology and habitat are thus limited to birds.

Earthworks will generate dust and high noise levels (i.e., 85-108 dBA; see noise emissions in Section 8.5.2) that can impact bird species (e.g., IUCN near threatened: Kentish Plover). Migrating birds over the site between the IBAs are particularly vulnerable to noise (and light pollution at night) and can also be affected by exposed stockpiles of hazardous and non-hazardous waste (i.e., through ingestion particularly during preening).

The magnitude of the potential impacts to terrestrial ecology caused by construction activities is typically negligible considering all land take required during the construction phase will be located inside the reclaimed (i.e., barren) LNG site or within existing disturbed and typically barren corridors with regard to pipelines and the power transmission line. Considering minimal terrestrial flora and fauna on and around the site (with the exception of bats, birds and invertebrates as detailed in Section 4.2.3) and no functional habitat on site, receptor sensitivity is considered low. Project noise is expected to completely attenuated before it reaches the IBAs and good housekeeping (e.g., no exposed waste, particularly food waste) is expected to minimise exposure to hazardous material and discourage fauna from the using the site. In addition, birds are accustomed to industry in the area and can easily avoid the Project site. Consequently, the overall significance of this impact is **Negligible**.

Potential impact descriptors for THE1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	30 months	Local	NEGLIGIBLE	LOW	**Negligible**

Operation and Maintenance Phase

THE2 - Disruption to terrestrial ecology and habitat from, waste, noise and air emissions, and flaring during operation.

Operational Project light, noise, and air emissions can disturb resident and seasonally migrating birds moving to and from IBA's (See section 4.2.3). While emissions will be continuous (i.e., 24 hours), resident birds are expected to move away or become accustomed to the change. Migratory birds are likely to be affected only when leaving and arriving on a seasonal basis (i.e. bi-annually over roughly a month).

Operational noise and atmospheric emissions are detailed in Sections 3.7.7and 0 respectively. All emissions will comply with Oman legislation and are not anticipated to significantly affect terrestrial ecology (i.e., birds). While research is typically lacking, there is precedent (Burke *et al*., 2012; McAlpine, 2013; Day *et al.*, 2015) that flaring at night can attract and disorientate migrating birds, leading to injury through collisions and burns. Hazardous and non-hazardous waste (including wastewater) will be appropriately managed (i.e., contained and disposed) and is not expected to impact terrestrial ecology. Food waste generated by the site office may attract animals on the site (e.g., rodents and cats) but will likely have a negligible effect due to appropriate containment and disposal by a suitably registered waste management contractor.

While terrestrial ecology (i.e., birds) will be affected in the long term (i.e. >25 years), impact is typically localised to the Project site and likely to be small scale. Bird species associated with the Project are listed in section 4.2.3 and are not classified as threatened (i.e., they are of 'least concern' IUCN, 2020) however populations of the Lesser Sandplover (*Charadrius mongolus)* and the Kentish Plover (*Charadrius alexandrinus*) are under 350 individuals (year of estimate 1989-1992). Both species live for ~5 years (IUCN, 2020) and populations can therefore be affected over five generations during the Project's lifespan (i.e., 25 years).

As indicated in the Project description (Section 3.7.7.2) , the plant will be a zero-flaring plant where flaring will be rare as it will only occur during plant start-up, shut-down and emergency situations. During normal operation, the tips of the warm flares will be active (i.e. lit) to ensure ignition when needed. Light and heat from the flare tips can be a continuous long-term impact. Light is anticipated to be comparable to low powered electric lights on the facility at night and heat is not likely to cause significant injury to birds. As one or more generation of bird species can be affected, impact magnitude is medium, although the population of birds is not anticipated to be threatened. Given that affected bird species are not threatened or endangered, medium sensitivity is attributed to low local abundance of the Lesser Sandplover and the Kentish Plover in the context that global population numbers are unknown with regard to the former, while the population of the latter is decreasing (IUCN, 2020). Overall impact significance is accordingly **moderate**.

Potential impact descriptors for THE2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	25 years	Local	MEDIUM	MEDIUM	**Moderate**

Decommissioning Phase

THE3 – Disruption to terrestrial ecology and habitat from waste generation and handling of hazardous material

Disruption to terrestrial ecology and habitat during decommissioning is viewed as the same as that during the construction phase (discussed above). As with construction, impact magnitude is typically localised to the Project site and small scale. Bird species populations are not expected to change or become threatened and impact magnitude is accordingly negligible. Given that affected bird species are not endangered, sensitivity is low and overall impact significance is **negligible**.

Potential impact descriptors for THE3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	30 months	Local	NEGLIGIBLE	LOW	**Negligible**

8.5.7.4 Mitigation measures

Mitigation methods will be different during each project phase. Recommended mitigation measures are as follows:

General mitigation measures

- Appropriate storage and disposal of non-hazardous (including food) and hazardous waste generated during all phases (e.g., closed bins and frequent disposal).
- Installation of fencing and barriers during all phases to ensure terrestrial wildlife in the project vicinity are kept out of the operational areas of the site.

Construction Phase

- Organized storage of all construction material and barrels in the laydown area.
- Through the implementation of the Waste Management Plan, appropriate storage and containment of construction material and hazardous material in the laydown area.
- Dust suppression to minimize dust generation.
- See Noise mitigation measures in Section 8.5.2.

Operational and Maintenance Phase

- Through the implementation of the Waste Management Plan, organized storage of hazardous material/substances and waste storage areas.
- Ensure all transportation vehicles maintain allowed routes and abide by speed limits.
- Regular maintenance of operational equipment in LNG train;

- Providing secondary containment for storages of hazardous liquids (lubricants, fuel for generators, etc.) required for the operation of plant equipment (i.e., pumps, compressors, standby generators etc.)
- Immediately notifying to the operations team / control room of any leaks and spills as per Emergency Response Plan.
- Minimise lighting levels, eliminating unnecessary lighting and use screens to reduce nightglow and the extent of visibility of the LNG port;
- Minimise duration that temporarily stored contaminated storm water is kept on site.
- Installation of bird deterrent-reflectors should be considered near infrastructure that may attract or harm birds (e.g., flare and waste storage).
- MARSA LNG LLC shall engage with SIPC for the establishment of a Biodiversity Management Plan including a bird monitoring program to assess the effect of flaring, though engagement with SIPC and other industries carrying out flaring in the SIP area, and put in place appropriate mitigation measures.

Decommissioning Phase

- As per construction mitigation measures.

8.5.7.5 Residual impacts

As the potential impact is **negligible** for construction and decommissioning phases considering the short-time impact; additional mitigation does not affect the overall impact significance. Potential impacts during operation relate primarily to heat and light from flare tips and flaring with an overall significance of Moderate. With the implementation of mitigation measures, magnitude is reduced to small and overall significance is minor. In addition, it is recommended that an audit be conducted to confirm that no nearby important species are impacted by the Project.

Residual impact descriptors for THE1 and THE3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	30 months	Local	NEGLIGIBLE	LOW	**Negligible**

Residual impact descriptors for THE2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	25 years	Local	SMALL	MEDIUM	**Minor**

8.5.8 Seawater and Sediment Quality (SQ)

8.5.8.1 Impact Identification

Table 8-24 Summarises the key potential impacts arising from the Project to Seawater and/or Sediment Quality (SQ). Further detailed assessment is described in the subsections that follow.

Table 8-24 Key Potential Impacts – Seawater and/or Sediment Quality

Construction and Commissioning phase	Operation phase	Decommissioning phase
SQ1 – Degradation of marine environment quality construction and commissioning activities and materials	SQ2 – Degradation of seawater and sediment quality as a result of vessel and jetty operations, and storm water runoff	SQ3 – Degradation of seawater quality due to vessel operations and storm water run off

8.5.8.2 Key Considerations

Box 8-9 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Box 8-9 Key Considerations for Assessment – Seawater and Sediment Quality

Sources of Impact

- Construction & decommissioning: Vessel movement (construction, offshore-onshore transportation and traffic).
- Operations: Jetty operations, ship operations, storm water discharge from common utilities corridors only (NB storm water, wash down water and fire water originating from within the plot boundary will be sent to third party wastewater treatment plant).

Particular Baseline Conditions that Potentially Influence Impacts

- Clearing discharged sediment from the seabed after construction of Sohar Port South (SPS) land will reduce sediment available for resuspension during the Project.
- No sensitive marine habitats occur within the Project's area of potential impact.

Project Factors that Potentially Influence Impacts

- Storm water drainage system for the common access and utility corridor will be used by all future tenants of SPS area
- Construction, pre-commissioning and commissioning period for the Project is assumed to be 34 months
- Operational period of the Project is assumed to be 25 years

Relevant existing Controls/Mitigations

- Solid and Hazardous Materials and Waste management
- Wastewater treatment/disposal mitigation
- Management and temporary storage of storm water generated within the battery limit
- Vessel discharge standards specified in MARPOL and national legislations
- IFC (2017) Environmental, Health and Safety Guidelines for LNG Facilities will be implemented.

The following subsections describe the impact evaluation over the project's three phases.

8.5.8.3 Impact Assessment

Construction and Commissioning phase

SQ1 – Degradation of seawater and sediment quality from construction activities

This section refers to construction activities that may degrade seawater and sediment quality, such as the release of sediments washed into the sea during storm events, wind-blown litter. However, this section does not address any impacts associated to construction barges and vessel movement activities, required for the jetty subsurface construction.

As outlined in Section 3.3.2, the jetty construction is an associated activity of the Project and has been permitted by EA (previously MECA) through an EIA (WSP, 2019). In keeping with WSP (2019), jetty construction can adversely affect seawater and sediment quality by locally increasing fine surface sediment and fine suspended sediment during construction and would release minor quantities of corrosion products during the latter stage of construction and commissioning. Increased suspended sediment during the construction of the jetty has minimal potential to adversely affect the quality of water drawn through the MISC sea water intake. For more detailed information related to the construction impact (and mitigation) of the jetty, please refer to the EA (previously MECA) approved EIA (WSP, 2019). While the jetty layout and location has changed slightly since the first design presented and assessed in the EA (previously MECA) approved EIA (WSP, 2019), it is considered that the previous impact assessment still remains valid. As indicated by SIPC through an exchange held on the 31st of July 2023, since the previous approved EIA (WSP, 2019) covered a wider area, no additional study of the impacts to the marine environment needs to be carried out as per Omani requirements – only a communication of the new coordinates of the jetty to the EA needs to be made in writing.

Shipping operations within the port itself (which are under the control of third parties), and movement of equipment and materials by land have been excluded and non-routine events such as marine accidents and spills are addressed in Section 8.8. Therefore, this section only considers routine and planned activity during the construction, pre-commissioning and commissioning phase.

The potential increase in turbidity caused by vessel movements has the potential to increase the concentration of suspended matter in the water column, so this section only considers the effects of reduced water quality (increased turbidity and total suspended sediment concentration) and sediment quality (i.e. re-settlement of fines). The ecological consequence of this impact is described in the section relating to marine habitats, Section 8.5.9.

The current baseline for sediment quality in the vicinity of the Project indicates a fines content of 15-30%. Baseline seawater quality is considered good according to the EIA conducted for the SPS Dredging and Reclamation Project. No land reclamation or dredging activities will take place as part of MARSA LNG LLC's Bunkering Project.

Impacts may be temporary (e.g., sediments conveyed into the marine environment during storm events or re-suspended by vessel movements causing temporary increased suspended sediment in the water column), or long-term (e.g., small volumes of non-biodegradable litter such as plastic, potentially toxic materials such as lubricants, solvents, paints etc. into the water column and being incorporated into the sediments). This has some minor potential to impact the quality of the seawater and/or sediment in the vicinity of the Project area, depending on the type of material entering the marine environment.

Receptor sensitivity ranges from low to medium because although the surrounding habitat is uniform fine sand and therefore of low sensitivity, the project area is immediately adjacent to the common seawater intake operated by MISC which supplies seawater commercially to industrial tenants for cooling and desalination purposes to a specified standard. Seawater quality itself is therefore commercially important, and is therefore considered of medium sensitivity.

The potential impact to sensitive receptors is of small magnitude as impacts would occur on a local scale only, i.e., within the direct area of influence, alongside the jetty, immediately adjacent to the plot and in the approaches to the jetty etc. Vessel operations associated with marine construction of the jetty (tugs, cargo vessels etc.) represent a possible source of sediment resuspension (Hayes et al., 2006). Impacts would be on a temporary basis (sediment disturbance from individual vessel movement during the construction phase) and while the estimated number of vessels moving into the direct area of influence during construction phases is currently unknown, the number is expected to be low to insignificant relative to the vessel movements associated with normal port operations..

Management measures consistent with IFC EHS guidelines for LNG facilities (2017) will be in place for construction waste streams such as the disposal of hydro test waters (See Section 3 Project Description). Given the relatively low risk and the small quantum of impact attributable to the Project during the construction phase, and the fact that impacts are reversible and would occur on a local scale, we consider the significance of this impact to be **negligible.**

Potential impact descriptors for SQ1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	NEGLIGIBLE	LOW to MEDIUM	**Negligible**

Operation and Maintenance Phase

SQ2 - Degradation of seawater and sediment quality arising from vessel operations and jetty operations, and storm water run off

Operational activities such as the movement of LNG cargo vessels, vessels taking on LNG bunkers and movements of support vessels is described in the Project description under Transportation and Traffic (Section 3.7.6). One bunker vessel per day in conjunction with possibly 1-2 export carriers on average per month will visit the jetty during operations. Vessel frequency is thus classified as occasional (i.e., intermittent and not continuous) within the direct area of influence for the duration of the operational life of the facility which is expected to be 25 years. In the definition of this impact we include small (5 – 1000 litres of persistent oils) operational spills which are expected rarely each year on average (i.e. Tier 1 which is defined as a spill having only a local impact and which is typically managed by company resources in a matter of hours or days using basic equipment). Operational spills and discharges from shipping mostly originate from discharges of oily water from bilges (the oil content of such discharges is limited to 15 ppm under MARPOL) and can negatively impact seawater quality to a minor degree. Other potential sources of impact to the marine environment from vessels include occasionally dropped objects, wind-blown litter, wash down water, leached anti-foulants from hull coating systems etc.

Furthermore, corrosion protection of steel elements of vessels and jetty legs will require the use of sacrificial anodes which preferentially corrode into seawater and will therefore need to be replaced periodically. Depending on their composition, anodes will often release small amounts of aluminium or zinc into the water where it will be available to be taken up by phytoplankton or adhere to suspended organic or inorganic material and either be captured by filter-feeders or become incorporated into the sediments (Rousseau et al., 2009). Depending on their quality, anodes may also contain other metals such as chromium, cadmium, lead and copper as alloys or contaminants, which would also leak into the environment and accumulate over time.

All storm water (and wastewater generated by wash down or fire control) generated within the battery limit will be collected and sent to an external wastewater treatment facility. Thus, any risk to the marine environment arising from storm water only arises rarely if the diversion system fails or is overwhelmed during an extreme event.

During rain events run off from roads and the common utilities corridors (pipeline alignments and easements along roads) will enter the storm water drains and be conveyed directly to the marine environment. Given the small average number of rain events each year, contaminants (e.g., oil and hydraulic fluid leaks, minor spills of truck loads, particulates from break wear and corrosion of vehicle parts) will accumulate on the road surface between occasional rain events. The generation of storm water runoff from the road and utility corridor has potential to have an adverse impact on discharge to the marine environment, largely because of contaminated suspended sediments associated with the first flush and would enter the storm water drain, where they would adhere to any wind-blown sand that has accumulated before being transported and discharged into the sea. Only contamination from vehicles serving the facility would be attributable to the project. However, the impact arising from the discharge of contaminated storm water is limited by the relatively small area of the common utility corridors, the relatively low number of expected vehicle movements required to service the facility during operations, and the application of mitigation measures already designed into the project description, including those outlined in the World Bank EHS guidelines for Ports, Harbours and Terminals (2017). Such measures are already incorporated into the Project Description and standard design and operating procedures within SIPC, who are responsible for the management of common utilities and infrastructure in the Sohar Port Industrial Estate.

The risk and magnitude of the potential impact is considered small, because the volume of contaminants entering the environment would be low, released slowly (in the case of sacrificial anodes) or occasionally (in the case of discharges from shipping and storm water) for the duration of the operational period. The spatial scale of impact would be relatively small (e.g., at storm water discharge points and the vicinity of the jetty). Receptor sensitivity ranges from low (sediments) to moderate (seawater quality), the latter being more sensitive since it is a commercially important resource that is supplied by MISC to its clients that use it and are dependent on it for cooling processes and as raw water for desalination. As such, the overall impact significance is **negligible to minor.**

Potential impact descriptors for SQ2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Permanent	Seldom to Often	Local	SMALL	LOW to MEDIUM	**Negligible to Minor**

Decommissioning Phase

SQ3 – Degradation of seawater and sediment quality due to vessel operations and storm water run off

The generation of storm water runoff from the common utility corridors has potential to impact the seawater quality throughout the construction, operational and decommissioning phases of the Project in the manner described above. During the decommissioning phase it is likely that material will be removed from the site in dump trucks that will introduce soil and potentially contaminated materials onto the road surface. Rainfall events during the decommissioning phase (expected to last 12-18 months) therefore have the potential to wash any such material into the storm water drainage system and into the marine environment unless it is properly controlled through management of the road surface and storm water drainage system.

Similarly, decommissioning activities may involve ship movements (i.e., removal of structures requiring vessel support, removal of spent catalyst, and possibly the re-deployment of the facility to another location following refurbishment etc.), which will mean that the risk of ship based environmental impact will persist over the decommissioning period. However, alternative options to the removal of the plant by vessel exist, so this scenario is only one being considered in the current stage of the project.

The magnitude of the impact is expected to be similar to the construction phase, but since the duration of decommissioning phase is approximately half that of construction, and since removal of the facility by vessel is only one option being considered at this stage the impact is considered **negligible.**

Potential impact descriptors for SQ3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	NEGLIGIBLE	LOW to MEDIUM	**Negligible**

8.5.8.4 Mitigation measures

The preferred method for controlling potential impacts to seawater and sediment quality is to implement mitigation measures at source combined with routine monitoring and adaptive management given in appropriate environmental management plans. Mitigation methods are designed to be relevant to the source and proximity of receptors and would apply during all phases. Recommended mitigation measures for potential impacts to seawater and sediment quality are as follows:

General Mitigation Measures

- Where feasible, storm water from loading jetty topside and surfaces should not be allowed to drain directly into the sea. During commissioning, the wastewater treatment system will be in place and wastewaters arising will be sent there.
- A Waste Management Plan and Pollution Prevention and Control Plan will be implemented, aimed at maintaining correct storage, treatment and disposal of operational facility and vessel wastewater streams and discharges (Abate at Source/Site).
- Litter, spills, and leaks will be cleaned up immediately.
- MARSA LNG LLC shall engage with SIPC regarding the release of contaminants to the marine environment associated to the jetty construction activities. While the jetty construction activities are outside the scope of this ESIA, it is recommended that the corrosion protection system used on the loading jetty (to be designed and installed by SIPC) should limit the release of contaminants to the marine environment (e.g. less harmful materials such as aluminium or zinc should be used). Noting that while the jetty substructure is an associated facility of the Project because MARSA LNG LLC will have its exclusive use, the maintenance of the jetty structure is not within the direct control of MARSA LNG LLC. MARSA LNG LLC shall exercise a duty of care to ensure that these structures are appropriately managed for any environmental risks arising, particularly in relation to marine contamination potential.
- Develop a Sediment Control and Storm Water Management Plan for the construction and operational phase that addresses scenarios arising from expected events (i.e., with 25 year return period) and extreme events (with longer return periods) for exposed surfaces within the battery limit. If management and maintenance of common utility corridors carrying infrastructure for MARSA LNG LLC's exclusive use, such as the condensate pipeline, buried electrical power cables, etc., are not within the direct control of MARSA LNG LLC, then MARSA LNG LLC shall exercise a duty of care to ensure that they are appropriately managed for any risks arising from these associated facilities. The duty of care shall include periodic visual inspection of unprotected surfaces, including after storm events, and, if necessary, monitoring of sediment volumes and quality. Similarly, MARSA LNG LLC should be diligent about ensuring that SIPC maintain storm drains to be kept reasonably free from sediment build up and vegetation growth. MARSA LNG LLC should develop a schedule of periodic storm water drain inspections and should take ownership of maintaining a clean road surface, should any traffic to the facility cause a spill or contamination of the road surface.
- Maintaining seawater quality is essential to minimise risk to marine ecology (which provides a potential pathway for contaminants to enter the human food chain via seafood) and commercial seawater users such as MISC and their tenants. Routine monitoring of ambient seawater and

sediment quality will be conducted within the project area during construction and operational phase through specific environmental monitoring plans aimed at the offshore section of the Project.

- MARSA LNG LLC shall engage with SIPC and request that SIPC periodically (annual) monitors sediment quality around areas where marine operations will take place to confirm sediment quality during jetty construction prior to making the facility available for MARSA LNG LLC operations. This item is the responsibility of SIPC since it falls with the definition of handing over a site for development that is fit for purpose.

8.5.8.5 Residual impacts

The residual impact significance on seawater and sediment quality from construction, operation and decommissioning of the Project is considered to be of **negligible** significance. Although many of the possible impacts identified in this assessment will be short-term and localised, periodic monitoring is recommended in order to confirm that the proposed mitigation measures are effectively addressing potential impacts and risks. This is particularly necessary with respect to operational spills and potential contamination arising from marine operations. Key thresholds and trigger events should be given in the Environmental Monitoring Plan to ensure that seawater and sediment quality remain compliant with international, regional and national standards and that adaptive management can respond to any changes in environmental quality or increase in risk.

Residual impact descriptors for SQ1, SQ2 and SQ3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary (SQ1-3) / Permanent (SQ2)	Occasional	Local	NEGLIGIBLE	LOW to MEDIUM	**Negligible**

8.5.9 Marine Ecology and Habitats (ME&H)

8.5.9.1 Impact Identification

Table 8-25 presents the key potential impacts of the Project on Marine Ecology and Habitats (ME&H). Further detailed assessment is carried out in the following subsections.

The scope of this assessment includes the risk of introducing alien species. Underwater noise is considered in the section that follows which addresses species of conservation value as these are the most sensitive marine receptor for this source of impact.

It is also important to draw attention to the relationship between the preceding section addressing seawater quality and sediment quality and this section which is focused on ecological systems and processes. Seawater and sediments in the previous section are treated as simple physical resources. In this section both seawater and sediments are considered to be marine habitats in their own right: many marine organisms spend their entire life cycle in one or other or both, so this section considers their role in the marine ecological system as a whole, both as a habitat *per se* and in terms of the ecosystem services they provide, such as feeding grounds for commercially important fish species and as a life support medium for biodiversity. In short, the distinction between these sections is that only physio-chemical properties of seawater and sediments are considered in the section above, whereas in this section their ecological value and function are considered together with other habitats (such as mangroves, seagrasses etc.) that may be present in the vicinity and their ecological function (such as feeding grounds, nursery area, spawning ground, dispersion of gametes and eggs etc.).

Table 8-25 Key Potential Impacts – Marine Ecology and Habitats

Construction and Commissioning Phase	Operation Phase	Decommissioning Phase
ME&H1 – Degradation of marine habitat quality and ecosystem function from construction activities.	ME&H2 – Degradation of marine habitat quality and ecosystem function due to operation activities.	ME&H3 – Degradation of marine habitat quality and ecosystem function decommissioning activities.

8.5.9.2 Key Considerations

Box 8-10 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Box 8-10 Key Considerations for Assessment – Marine Ecology and Habitats

Sources of Impact

- Ecological consequence of impacts to seawater and sediment water quality such as: i) Marine operations i.e., shipping and jetty operations, ii) Storm water runoff from common utility spaces, iii) Improper disposal of solid and liquid non-hazardous and hazardous waste
- Introduction of marine alien species.

Particular Baseline Conditions that Potentially Influence Impacts

- No sensitive marine habitats within Project area
- Gap in marine biodiversity inventory and monitoring at Sohar Port

Project Factors that Potentially Influence Impacts

- Construction, pre-commissioning and commissioning period is ~34 months
- Operational period is ~25 years
- Compliance with national legislation and international conventions to which Oman is a party (e.g. MARPOL) are considered as part of the Project description i.e. base case.

Relevant existing Controls/Mitigation Measures

- Appropriate waste disposal as per applicable national legislation and IFC Guidelines for LNG facility operations
- Appropriate wastewater management and disposal including hydro-test, and storm water generated within the battery limit
- Standard operating procedures required by Sohar Port

The following subsections present the impact evaluation during the three project phases.

8.5.9.3 Impact Assessment

Construction and Commissioning phase

ME&H1 – Degradation of marine habitat quality and ecosystem function from Project construction activities

During construction, transportation of material and equipment manufactured overseas (i.e., pipeline components, compressors and turbines etc.) will be transported by sea to Sohar Port and then transferred to the relevant Project locations via heavy lift transports, low-loaders or other means.

Support vessel operations associated with marine construction (tugs, cargo vessels, etc.) can represent potentially significant sources of sediment resuspension (Hayes et al., 2006) as described in the preceding Section. Impacts would occur on a local scale only, i.e., within the AoI, and on a short-term basis (i.e., sediment disturbance from individual vessel movements). However, as any vessel related construction activities will be carried out by SIPC and are considered in the previously permitted EIA for the jetty construction (WSP,2019), these impacts are not under the scope of MARSA LNG in the construction phase.

Changes in seawater and sediment quality can have an ecological impact by changing the conditions at the site e.g., increased turbidity can reduce the amount of light available for benthic primary producers (in this case mostly by diatoms on the sediment surface) which can reduce the production of oxygen during the day. Also, construction material / litter may be blown or otherwise transported to the marine environment: materials having the greatest ecological impact would be wind-blown plastic and polystyrene packaging which eventually break down physically into micro-plastics, and contaminants which have a propensity to bio-accumulate higher up the food chain.

The potential impact is of a localized nature and existing mitigation measures are in place for effective waste management (See Section 3 Project Description) in line with World Bank EHS guidelines for LNG facilities (2017). Due to the localized nature of these activities, the magnitude is small.

Receptor sensitivity (e.g., shallow benthic habitats and the associated water column) is considered low as the habitat is typically comprised of uniform sand and an homogeneous water column, with no sensitive marine habitats (e.g. coral communities, mangrove stands and seagrass beds) occurring in the zone of potential impact, and will occur during a limited time frame. Consequently, the overall impact significance of this category of impact is **negligible.**

Potential impact descriptors for ME&H1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

Operation and Maintenance Phase

ME&H2 – Degradation of marine habitat quality and ecological function arising from Project operational activities

The potential increase in turbidity and suspended matter as a result of long-term (~25 years) vessel movement/shipping during loading/unloading activities in the operational phase can indirectly impact the local marine ecology due to increased levels of turbidity and suspended sediments in the water column, although this will be reduced near the loading jetty as vessels will be manoeuvred onto the moorings by tugs.

Other potential impacts arising from ship operations include the accidental introduction of alien marine species, ecological effects arising from small operational oil spills, hormone disruption arising from leaching of active ingredients in anti-fouling paint (e.g. TBT), bioaccumulation of zinc and other trace elements released from sacrificial anodes on jetty legs and other steel surfaces (Rousseau et al., 2009), ecological impacts arising from oils in bilge water discharged overboard (limited to 15 ppm under MARPOL), and ecological effects arising from wind-blown litter (e.g. generation of microplastics). The number of vessels moving within the AoI at any given time is unknown; nonetheless it is expected that an LNG bunker vessel may offload daily, whereas an export carrier close to once a month (see Section 3.7.6). Assuming a maximum of two vessel movements per day within the AoI, it is expected that there will be an effect arising of suspended material on light availability for certain autotrophic taxa (e.g., benthic diatoms), reduction on the feeding of visual predators (Hecht & van der Lingen, 1992) and hindering of respiratory functions of filter feeders

(Wahab et al, 2017) such as those previously recorded on the Majis jetty piles. Habitats and communities in the vicinity of the Project are generally low diversity and provide few recognised ecosystem services; thus, the magnitude of the impact is considered low**.**

The risk of introducing alien invasive species during routine operations is an important marine environmental risk arising from the Project. This risk can be divided in two basic aspects: first, the likelihood of an introduction of any marine alien species (which is considered in this section), and second the risk of introducing an invasive marine alien species that cumulatively causes effects on infrastructure and associated economic damage (which is considered in Section 8.10). Shipping will come to within a few hundred meters of the intake structure of the MISC seawater cooling system, which is a significant change with respect to operational arrangement of Sohar Port.

The risk of introductions arises from both the discharge of ballast water (mostly limited to planktonic species) as well as from the fouling community living on ships hulls (mostly limited to benthic invertebrates and algae) colonising marine substrates at the terminal and nearby revetments, forming viable colonies and then spreading further. Introduced alien marine species can lead to macro-fouling (i.e., impairment of hydraulic function) of the MISC seawater intake system (e.g., particularly screening systems) which may have implications for the seawater distribution system that provides cooling industrial processes and raw seawater for desalination.

Incidents of problematic ballast water discharges are unlikely due to the requirement to comply with the international convention for the management of ballast waters and sediments, which came into force in 2017. Under the convention ships are required to follow an approved ballast water and sediment management plan and maintain a ballast water record book. However, currently there are no measures in place in Oman to assess or control the risk of introduction of invasive species from hull fouling or the residual risk arising from ballast water discharges. Other types of discharge are managed under national and international legislation, controlling the quality of discharges from vessels.

In terms of assessing the risk, frequency and magnitude of the potential impact to marine habitats and ecosystem function, a holistic approach has been taken in which we qualitatively combine each identified source of impact. This approach has been selected because there are numerous identified sources and each has a different duration, likelihood, frequency, extent and magnitude. As it is unknown where all vessels will originate, the risk of alien species cannot be accurately estimated. While unlikely, the introduction of a marine alien species could have a Small to Medium magnitude, whereas bioaccumulation of zinc from sacrificial anodes (if used) would be certain but would have a small to negligible and local effect only. Operational spills will occur occasionally and impact magnitude is likely to vary from negligible to small. To confirm the magnitude associated to this impact/risk, a qualitative risk assessment would need to be conducted according to accepted guidelines for conducting such risk assessments e.g., IMO Globallast Risk Assessment Methods.

In all cases the precautionary principle is applied in this assessment to describe the worst case scenario. Overall impact magnitude is thus considered to be small to medium. The receptor sensitivity (i.e., marine ecology and ecosystem function within a radius of two km from the terminal) is considered low. As such, the overall impact significance is expected to range from **negligible to minor.**

Potential impact descriptors for ME&H2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Permanent	One-off to Often	Local	SMALL TO MEDIUM	LOW	**Negligible to Minor**

Decommissioning phase

ME&H3 – Degradation of marine environment quality from Project decommissioning activities

Decommissioning activities (i.e., removal of structures within the battery limit etc.) may require continued vessel activity within the direct area of influence over a relatively short period, although recycling, reuse and disposal of the plant is expected to be largely serviced by local suppliers using local facilities. However, it is possible that the plant may be re-conditioned and relocated by sea elsewhere; at this early stage in the Project such details are uncertain so the following two scenarios are considered here: dismantling followed by i) local reuse/recycling and disposal, ii) refurbishment and transport to an overseas location for re-use.

Decommissioning activities can generate large volume of waste (i.e., removal of structures, generation of construction & demolition waste) during a short-term period estimated to be 18 months, half the period required for construction. Key types amongst these include materials that are particularly difficult to manage such as contaminated dust and fine sediment, cuttings and metallic micro-spheres generated by thermal cutting tools and grinders. For these to impact marine ecology they would need to be transported to the sea either by wind or during storm events. Impact magnitude and receptor sensitivity is expected to be small and low, respectively, and because of the shorter duration of the decommissioning phase compared to the construction phase the overall impact significance is considered **negligible.**

Potential impact descriptors for ME&H3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

8.5.9.4 Mitigation Measures

As before, the priority must be given to controlling potential impacts to marine habitats and ecological function at source, combined with routine monitoring as part of an adaptive management framework. Mitigation methods will depend on the source and proximity of receptors and should be applied during all phases. Mitigation measures that must be implemented are outlined below.

General Mitigation Measures

- Follow mitigation measures set out in previous sections for minimising/managing impacts to seawater quality and sediment quality.
- Maintain correct storage, treatment and disposal of construction waste and water streams and discharges including any temporary storm water systems put in place during construction (Abate at Source/Site).
- MARSA LNG LLC shall engage with SIPC regarding the maintenance of correct storage, treatment and disposal of operational vessel wastewater streams and discharges, including storm water systems (Abate at Source/Site), through specific management plans such as a Pollution Prevention and Control Plan and a Waste Management Plan.
- MARSA LNG LLC shall engage with SIPC regarding the maintenance of support on general IFC shipping safety management strategies and develop pollution management plan to include relevant elements to MARSA LNG LLC such as:
  - Hazardous materials:

    - Operational certification of the ship according to applicable requirements depending on the purpose and capacity of the vessel;
    - Preparing and implementing spill prevention procedures for bunkering activities in port and at sea. For oil tankers taking on LNG as bunker fuel, follow the applicable requirements, and only permit double-hull design access to the loading jetty area as a spill prevention measure;
    - Prohibit ship to ship transfer of cargo (lightering) and bunkering activities in accordance with specific safety regulations and guidance to minimize the risk of spills;
    - Preparing and implementing spill prevention procedures for LNG carriers and oil tanker bunkering according to applicable standards and guidelines which specifically address advance communications and planning with the receiving terminal;
    - Adequately securing hazardous materials and oil containers on deck;
    - Maintain emergency plans to address accidental releases of LNG, oil or noxious liquid substances;
    - Maintaining the necessary specific oil and noxious liquid substances spill prevention plans and procedures for operations in Special Areas (Annex I and II of MARPOL 73/78).
  - Establishment of a Biodiversity Management Plan that includes a Ballast Water Management Plan and a Management and Monitoring Plan for Alien Invasive Species.
  - Ballast water management plan must include but not be limited to:
    - Inspect and maintain a written record of cargo and ballast operations (Oil Record Book as noted in Annex I of MARPOL. 73/78, and Ballast Record Book as required under the Ballast Water Convention) for vessels arriving for bunkering and for LNG carriers arriving for loading bulk cargo and/or bunkers;
    - The Ballast Water Management plan for vessels using the terminal must be audited to confirm compliance with the requirements of the Ballast Water Convention.
  - Alien Invasive Species Management Plan must include but not be limited to:
    - In coordination with SIPC, who owns this risk for general operation of Sohar Port, carry out a high-level (rapid) risk assessment of invasive species risk during operational period and act on any recommendations arising.
    - If recommended by the risk assessment, carry out periodic (annual) and focused monitoring of fouling organisms on loading jetty legs and nearby revetment and armour units using rapid assessment techniques such as environmental DNA (eDNA) during the operational phase.
- Marine Operations: MARSA LNG LLC shall engage with SIPC with regards to the environmental standards and procedures applied to the LNG terminal operations and to Sohar Port generally. As the project moves towards the operational phase a detailed review of the environmental standards currently being applied by Sohar Port terminal operations should be conducted to ensure they are consistent with MARSA LNG LLC company standards, MARSA LNG LLC's Company methods for evaluating HSE aspects of LNG terminal operations. Apart from safety aspects, the focus on environmental management should include:
  - Discharges to the marine environment
  - Pollution prevention and controls
  - Ballast water and hull fouling management
  - Management of wildlife collisions

- Engage with SIPC for the establishment of "low power propulsion zones" in the Project area to minimize effects of underwater noise and disturbance of the seabed by propeller wash, in coordination with SIPC.

8.5.9.5 Residual impacts

Mitigation measures have been provided to ensure that marine habitat and ecological function is preserved. Given the relationship between marine ecology and the media in which this occurs (i.e. seawater and sediments), the control measures to maintain seawater and sediment quality (see section 8.5.8) will also contribute to mitigate most of the impacts to marine ecology that have been considered here. With such mitigation measures in place and strictly adhered to, the impact magnitude is considered to be small, resulting in an overall **negligible** impact significance in all three phases of the Project.

Residual impact descriptors for ME&H1 and ME&H3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	LOW	**Negligible**

Residual impact descriptors for ME&H2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Permanent	One off to Often	Local	SMALL	LOW	**Negligible**

8.5.10 Protected Species / Critical Habitat (PS/CH)

8.5.10.1 Impact Identification

Table 8-26 presents the key potential impacts arising from the Project on Protected Species and Critical Habitats, and these are described further the paragraphs that follow. The Arabian Sea Humpback Whale (ASHW) is the only species likely to be present within the Project Area, which triggers the IFC PS6 Critical Habitat status under Criteria 1 (see Section 5.3.8.6). However, other species such as the Sperm Whale, Bryde's Whale, Blue Whale, three species of marine turtles, Whale Shark and other species are listed in IUCN's Red List and are therefore sensitive receptors. Impacts relating to PS6 IFC Critical Habitats pertain solely to potential impacts on the ASHW. All receptors being considered in this impact category are highly sensitive because of their high value status, which is amplified by the scrutiny of the international stakeholders associated with international conservation including big international NGOs, as well as industry watchdogs and lobby groups.

The sources of potential impact of the generation of underwater noise and ship strikes are most relevant in the operation phase. Vessel related construction activities will be carried out by SIPC and are considered in the previously permitted EIA for the jetty construction (WSP,2019).

. To avoid repetition, the discussion of the different impact sources is given below and the subsections that follow describe the basis on which the metrics for the impact assessment have been determined. The magnitude of impact for each source scales with duration of the phase and the frequency of shipping operations during Project operation.

<u>Underwater Noise</u>

Sensitive marine mammal species, such as sperm whales, Bryde's whales and Arabian Sea humpback whales (see critical habitat assessment for details), may be physically harmed or have lower ecological fitness as a result of increased underwater noise generated by vessel operation/movement in the AoI. Marine turtles are less sensitive to underwater noise impacts than marine mammals, since they have a less well-developed auditory system because they have not evolved a communication system based on vocalisations or an echo-location system, unlike cetaceans. Noise emissions from shipping attributed to the project are considered to have direct and negative impact and contribute somewhat to the overall cumulative impact of underwater noise generated by normal operations at Sohar Port. Underwater noise degrades the quality of the habitat for sensitive cetacean species that occur in the vicinity of the main shipping lanes, including the approaches to the port and to the loading terminal in the project area.

The more significant effects of underwater noise on sensitive species include auditory threshold shifts (temporary or permanent), stress, masking of biologically important sounds (e.g., communication, echolocation, and avoiding threats), disruption of foraging, avoidance of particular areas, habitat displacement, and altered diving and reproductive behaviour, as described in the EIA for the Sohar Port South project (WSP, 2019). Such effects are expected to be typically short-term and localised/transient in nature as animals can avoid the Project area and move away from vessels generating loud noise. Increased noise is unlikely to result in increased fatalities (Southall et al., 2007; Lucke et al., 2009; Popper et al., 2006; NMFS, Howorth, 2003), but they may increase the risk of ship strikes due to masking, so noise and ship strike impacts should be considered to be synergistic for both cetaceans and turtles. Exposure to underwater noise is considered to be an ‘aggravating factor’ in vessel collisions, making it difficult for individuals to detect approaching vessels or fishing gear, either against background noise, or due to hearing loss/damage. Habituation of individuals to shipping noise may also cause cetaceans to respond less or not at all to vessel movements over time, increasing the risk of ship strikes (Ritter and Panigada, 2019; Weilgart, 2006; Andre et al., 1997; Todd et al., 1996).

Ship strikes

The risk of a ship strike is proportionate to ship traffic numbers, vessel speed and other factors such as whether a vessel is loaded or not. The increase in risk and impact of ship strikes attributable to the project is proportional to the project’s contribution to increased ship traffic at Sohar Port. Strikes are most severe when there is interaction between the animal and the ship’s propeller which often results in severe injury or death.

Collisions can occur with any type of vessel, and in some cases (particularly with large cargo vessels), captains may be unaware that a collision with a cetacean has occurred at all. In general, the faster the vessel the greater the risk of serious injury, with most fatal and serious wounds caused by collisions with vessels moving at speeds exceeding 13 knots, and/or by vessels that are over 80m in length (David, 2002; Laist et al, 2001; Carrillo and Ritter, 2010; Gende et al, 2011; Vanderlaan and Taggart, 2007). Effects of a vessel collision with cetaceans or marine turtles will at best leave an individual startled but uninjured while at worse it will result in either immediate or eventual death of the animal.

The magnitude of potential impacts to sensitive receptors i.e. protected species such as marine turtles, cetaceans, whale sharks etc., is considered to be generally low. The exception to this is the Arabian Sea Humpback Whale (ASHW). For this species a strike which would cause a large impact because of its critically endangered status and the small size of the sub-population which his less than 100 animals: impacts would most likely be irreversible due to the high risk of severe or fatal damage to individual animals involved in ship strikes.

Table 8-26 Key Potential Impacts – Protected Species / Critical Habitat

Operation phase	Decommissioning phase
PS/CH2 – Impacts to protected species and critical habitat from underwater noise and ship strikes	PS/CH3 – Impacts to protected species and critical habitat from underwater noise and ship strikes

8.5.10.2 Key Considerations

Box 8-11 presents the key potential Project impacts on surface water. Further detailed assessment is carried out in the next subsections.

Box 8-11 Key Considerations for Assessment – Protected Species / Critical Habitat

Sources of Impact

- Underwater noise from vessel operations
- Increased risk of ship strike from vessel operations

Particular Baseline Conditions that Potentially Influence Impacts

- Several sensitive marine species including four species of cetacean, three species of marine turtle and several species of shark including the Whale Shark
- One species triggers Critical Habitat: Arabian Sea Humpback Whale

Project Factors that Potentially Influence Impacts

- Construction, pre-commissioning and commissioning period 34 months
- Operational period 25 years
- Decommissioning period 18 months
- Ship speed is a significant factor for both underwater noise and ship strikes

Relevant existing Controls/Mitigations

TotalEnergies company standards for LNG Terminal Operations

The following subsections present the evaluation of impact criteria during the three project phases.

8.5.10.3 Impact Assessment

Construction and Commissioning phase

PS/CH1– Impacts to Protected Species and Critical Habitat arising from increased emissions of underwater noise and increased risk of ship strikes

The magnitude of the incremental impact of underwater noise and increased risk of ship strikes to sensitive receptors i.e., protected marine species, is negligible, given the small volume of additional shipping traffic that is attributable to the project during the construction period. Marine mammals are moderately sensitive to underwater noise, while marine turtles are considered to have low sensitivity and sharks are insensitive. All groups that periodically occur at the sea surface are moderately sensitive to ship strikes, whereas benthic species such as sawfish are not vulnerable to this risk. A collision with an Arabian Sea Humpback Whale would be considered significant although highly unlikely.

Both marine mammals and turtles occur in the area of influence and shipping lanes, but animals inhabiting this area are already subjected to disturbance from noise generated by existing port vessel traffic (WSP, 2019). It is a recognised data gap that the abundance and diversity of marine protected species in the area is not known with a high degree of certainty, but abundance is expected to be low in shallower coastal areas as compared with other parts of Oman’s territorial waters. The overall significance of this impact in the construction phase is **negligible**.

Potential impact descriptors for PS&CH1						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare	Local	NEGLIGIBLE	MEDIUM	**Negligible**

Operation and Maintenance Phase

PS/CH2 – Impacts to Protected Species and Critical Habitat arising from underwater noise and ship strikes

Operations, such as movement of LNG vessels accessing the facility's loading jetty, will generate an incremental increase in underwater noise and the risk of ship strikes over a long-term period (a minimum of 25 years). The impact is expected to be similar in nature to that occurring during the construction phase as described in PS/CH1 but extending over a period of 25 years of operation as opposed to the construction phase period. Over the operating period, it is possible that some species will become increasingly endangered and therefore their sensitivity may increase, and it is also possible that sensitive species may become more habituated to low-frequency underwater noise generated by shipping over time, making them more susceptible to ship takes (Andre *et al*., 1998). The overall impact significance is considered **minor**.

Potential impact descriptors for PS&CH2						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

Decommissioning phase

PS/CH3– Impacts to Protected Species and Critical Habitat arising from increased emissions of underwater noise and increased risk of ship strikes

As above, decommissioning activities (i.e., removal of structures, movement of vessels etc.) will continue to generate underwater noise and risk of ship strikes over the decommissioning period. The magnitude of the impact is expected to be similar to the construction phase as described in PS/CH1 above, albeit for a shorter duration (18 months of decommissioning vs 34 months for construction). The overall impact significance is **negligible.**

Potential impact descriptors for PS&CH3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Occasional	Local	NEGLIGIBLE	MEDIUM	**Negligible**

8.5.10.4 Mitigation Measures

The preferred method for controlling potential impacts to protected species and critical habitat is to implement mitigation measures at source, combined with routine monitoring. Mitigation methods will depend on the source and proximity of receptors and apply to all phases. Recommended mitigation measures for potential protected species / critical habitat impacts are provided below.

General Mitigation Measures

- General mitigation measures described for marine environment and habitats above are also applicable to manage impacts to protected marine species and critical habitat.
- In particular MARSA LNG LLC must use its influence on SIPC to ensure that shipping approaching and leaving the MARSA LNG LLC terminal is managed according to best practice including IFC Best Practice Guidelines for LNG facilities (2017) and MARSA LNG LLC's company guidelines for operating LNG terminals, including but not limited to the following measures:
  - MARSA LNG LLC shall engage with SIPC for the establishment of "low power propulsion zones" in the Project area to minimize effects of underwater noise and the risk of ship strikes. This is something that could be considered for implementation by SIPC port-wide.
  - MARSA LNG LLC shall engage with SIPC for the establishment of a Biodiversity Management plan that includes a Whale Mitigation Management Plan, similar to that which has been developed and implemented in the Port of Duqm. The plan involves a system for approaching ships to report whale sightings, temporary and localised speed restriction zones ('dynamic management zone') on approach, training and awareness raising about identifying sensitive species and the issue of ship strikes.

8.5.10.5 Residual impacts

As described in the World Bank EHS guidelines for ports, harbours and terminals (2017), mitigation measures to minimize the underwater noise generated by ship operation include the establishment of "low power propulsion zones" in and around port areas; this may also help to avoid ship strikes with marine wildlife. Combined with the implementation of an effective whale mitigation and management plan the impact magnitude of underwater noise is considered to be negligible, resulting in an overall **negligible** impact significance.

The establishment of permanent speed restriction zones may be applicable in areas where long-term patterns of whale distribution are predictable and well understood, but where routing measures are not practicable (i.e., on approach to a port) (IWC, 2015). The IWC Ship Strike Working Group is tasked with working on ship strike reduction measures specific to various high-risk areas or specific at risk populations, such as the ASHW (IWC, 2017). Focused work on the ASHW population for identifying and developing appropriate mitigation strategies is at Stage 3: "Consideration of possible practical options based on risk analysis. Recommendations from IWC Scientific Committee, IWC approaches relevant states to offer information and advice". As ASHW-specific mitigation measures are not currently available, establishment of permanent speed restriction zones and a Whale Mitigation Management Plan in the Project area are proposed as suitable mitigation measures in the interim period until ASHW-specific mitigation measures are published.

Residual impact descriptors for PS&CH1, PS&CH2 and PS&CH3						
Type	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct	Temporary	Rare/Occasional	Local	NEGLIGIBLE	MEDIUM	**Negligible**

8.6 Socioeconomic Impact Assessment

The following section presents the potential impacts of the Project activities on the social and health environment, i.e. local economy and employment; navigation, workers' infrastructure and public services; community health, safety and security; and workforce social issues.

8.6.1 Local economy and employment (EE)

8.6.1.1 Impact Identification

This section assesses the potential economic and employment impacts associated with the Project activities. Most of the economic and employment impacts from the Project can be expected to accrue during the construction and operation phases. It is during these periods that the Project will need to hire workers and purchase goods and services, potentially resulting in positive impacts on the local economy. Temporary employment during the construction phase includes people directly employed by the primary contractor for that phase. It also includes jobs supplying the goods and services needed to support the construction process, including food and transport services and support staff.

There are two potential impacts on the local economy and employment for construction and operation phases which are evaluated below:

- Direct and indirect employment opportunities (primarily unskilled); and,
- Economic impacts from taxes and fees, procurement and worker spending.

Table 8-27 presents the key potential impacts of the Project on local economy and employment. Further detailed assessment is carried out in subsequent sections.

Table 8-27 Key Potential Impacts –Local Economy and Employment

Construction and Commissioning phase	Operation phase	Decommissioning phase
EE1 – Temporary direct and indirect employment opportunities	EE3 – Long-term direct and indirect employment opportunities	EE5 – Temporary direct and indirect employment opportunities (primarily unskilled)
EE2 – Temporary economic impacts from taxes and fees, procurement and worker spending	EE4 – Long-term economic impacts from taxes and fees, procurement and worker spending	EE6 – Temporary economic impacts from taxes and fees, procurement and worker spending

8.6.1.2 Key Considerations

Box 8-12 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-12 Key Considerations for Assessment – Local Economy and Employment

Sources of Impact

- Pre-construction and Construction: construction workforce is estimated at maximum 1,800 workers during peak activity, working 10 hours per day and overtime of 2 hours for some sections. The workforce will consist of at least 30% Omanis and the remaining 70% of expatriates. Most of the employees will be sub-contractor staff engaged by the EPC contractor for executing various civil, mechanical and electrical works.
- Operations: operations workforce is estimated at 120 people. The work regime in operation phase will be on a resident basis and a limited number of staff will be on shift basis.

Particular Baseline Conditions that Potentially Influence Impacts

- At the governorate level, in Al Batinah North the population was 872,014 individuals as of 1 January 2023. Out of them, non-Omani nationals represent over one third of the population (35%) compared to 41.90% at the national level.
- In Sohar Wilaya (estimated total population was 269,900 in 2023), non-Omani nationals represent 52.30% of the population (higher compared to the national average). In Liwa (estimated total population was 63,296 in 2023), non-Omani nationals are 39.60%, below the national average but higher compared to 2019.
- High literacy rates (95%) but low rates of employment in mid-high-level positions. While local community and governmental stakeholders claim that education levels and multiple specialisations for highly qualified positions (i.e. engineers, managers, etc.) are available at the local level, there seems to be a discrepancy between the skills and qualifications that industrial companies in the Port are looking for and the skills available in the local market.
- As of 1 January 2023, 67.2% of the population in North Al Batinah were employed, 30% were inactive and 2.8% were job seekers. In Sohar Wilayat, there were 73.8% employees, 24.2% inactive people and 2% people seeking a job. In Liwa Wilayat, there were 69.7% employees, 28.2% inactive people and 2.1% people seeking a job.
- A 2022 quoting the World Bank indicated that unemployment remains higher among Omani youth aged between 15 and 24, and particularly among young women.
- Most of the commercial activities and community services are found in close proximity to the wilaya centres, Sohar and Liwa, historically developed around the historical fort central areas. The dispersed location of the urban centres and the rapid urban expansion is leading to major issues regarding infrastructure provision and economic development.
- The Sohar Port area and Freezone Port Area are already developed and include facilities and infrastructure that will be utilised by the LNG Bunkering Project.
- The Sohar Port Area and Freezone Port Area have experienced growth in all key areas. Land occupancy was 77% in 2022 and 14 new contracts were awarded. In 2022, total investment grew by 17%.[131]
- The Port of Sohar has been a key strategy from the government to reshape the governorates of Al Batinah to create more jobs for both the growing population in the Governorate and for Omanis relocating from elsewhere.
- Locals are not always prioritised during recruitment, with higher-level positions being filled by Omani nationals from other areas although required skills may be available at the local level. This generates a climate of competition between locals in the Northern portion of Al-Batinah and Omanis from other areas, which creates frustration among locals looking for work.

Project Factors that Potentially Influence Impacts

- The LNG Plant Construction Activities are expected to last about 34 months including commissioning and pre-commissioning.
- Once commissioned, the operational activities and maintenance activities will start at the LNG Site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- Goods and services will be sourced locally, where possible. Pipeline components, packages and main containers will be transferred through ship to the Sohar port and/or airfreight to Muscat Airport and then transferred to the relevant locations by trucks.

The following subsections present the impact evaluation during the three project phases (Construction and Commissioning phase; Operations phase and; Decommissioning phase)

[131] Sohar Port and Freezone announces impressive growth in all key areas - Times of Oman, accessed on 25 July 2023

8.6.1.3 Impact Assessment

Construction and Commissioning, Operations and Decommissioning

EE1,3,5 – Direct and indirect employment opportunities (primarily unskilled)

It is estimated that a maximum number of 1,800 workers will constitute the number of personnel involved in the construction in peak times during the 34-months construction period. Of this figure, at least 30% will consist of Omanis and the remaining expatriate workers. For the operations phase, the workforce will be significantly reduced to approximately 120 people. Decommissioning will be similar to construction phase and the number of workforce needed will depend on the approach taken. Thus, potential impacts on employment opportunities will be mainly held in the construction phase.

At a national level, the industry sector (which includes construction) is a relatively important economic activity, contributing to approximately 19% of GDP. ESIA baseline findings show that the nature of the job opportunities created by the industrial sector at the local level (i.e. at the Wilaya and settlement levels) is mostly short-term (1-2 years during the construction phase) and low skilled.

In the villages surrounding the Port, a high proportion of the working population (older than about 20 years of age) have grown up in a rural environment specializing in date farming, rearing livestock and fishing. The Sohar Port development and associated planning has led to a modification of the job composition of the area. Many people were not sufficiently trained or experienced to be able to access the job opportunities offered by the development of heavy industry.

While the Al Batinah governorate concentrate a high percentage of Omani population (approximately 65% of the population are Omanis, compared to 58% at a national level), it also has high unemployment rates, especially young people who have been protesting because of this in Sohar in 2021. The Port has been a key strategy from the government to reshape the governorates of Al Batinah to create more jobs for both the growing population in the Governorate and for Omanis relocating from elsewhere. In particular, the expansion of the Sohar Port South (50 ha added in the first phase and subsequent phases with added another 200 ha), has an objective to create new and sustainable jobs opportunities. Since recruitment during the construction phase is a duty of contractors and sub-contractors, the local content element is often lost, with little to no benefits at the local level. This generates a climate of competition between locals in the Northern Batinah and Omanis from other areas and has contributed to the unrest in Sohar in 2011, 2012 and 2013, including from settlements of the AoI such as Harmul and Liwa.

In some cases, companies within the Port and Industrial area enter into agreements with the Ministry of Labour (formerly Ministry of Manpower) to help train Omani nationals, supported by the National Training Institute (NTI) and National Training Fund (NTF), in order to employ them following adequate training. These company-sponsored training programs provide opportunities for formal employment with the companies at the end of the program and are therefore highly sought after. However, anecdotal feedback from local community and governmental stakeholders collected during SBS field survey discussions claim that education levels and multiple specialisations for highly qualified positions (i.e. engineers, managers, etc.) are available at the local level; however, as stated in the ESIA Baseline, there seems to be a discrepancy between the skills and qualifications that industrial companies in the Port are looking for and the skills available in the local market.

Those who are able to secure employment on the Project during construction but also during operations, will likely have the opportunity to improve their skills, gain experience and thereby improve their opportunities for future employment within the construction sector. In addition to on–the-job experience at the level of individual workers, the Project will also represent an opportunity for Omani companies to tender for work on different project-related components and basic services (e.g., food supply, maintenance), which will result in a capacity enhancement. In turn, capacity enhancement of local and national workforce and companies will also contribute not only to creating long-term employment opportunities for individuals and businesses, independent of the Project (indirect), but also contributing to positive mental health outcome. The benefits of job creation result in a combination of different outcomes such as income and subsequent access to resources, as well as psychological benefits such as role and status, access to social networks and support.

This impact is considered to be **Positive** and as such, a magnitude rating is not assigned.

EE2,4,6 – Economic impacts from taxes and fees, procurement, and worker spending

In general, construction and operation activities associated with the Project will likely generate economic benefits from taxes paid by the Project in-country and the region. The payment of taxes will generate a long-term (during entire Project lifecycle) impact. The purchase of goods and services from the local Omani market during construction and even in the operational phase will also generate benefits at national and regional level, and local where possible.

The mobilisation activities will consist of heavy equipment transportation, mainly through existing transportation routes, while raw materials will be sourced locally, where possible. Pipeline components, packages and main containers will be transferred via vessel transportation to Sohar port and then transferred to the relevant site locations via trucks. For those companies that meet the eligibility criteria and enter the supply chain, there will be short-term benefits to the businesses and their employees through increased experience, capacity and training opportunities. The economic benefits will therefore primarily occur at the regional and national levels.

In addition to direct employment, the Project will result in the indirect employment of workers through procurement of select local goods and services. Local and foreign workers that are off shift will also spend a portion of their salaries in the local area (food, transportation, and entertainment.) This increase in business for local service providers could potentially lead to increased incomes, additional hiring, and continued investment in these local businesses, allowing for further growth. Additionally, beyond ensuring appropriate capacity to perform work or deliver services to the Project and its contractors, the capacity-building initiatives delivered to workers and local suppliers will strengthen local workers' and entrepreneurs' skills and employability, providing employment and livelihood benefits over the longer term (as discussed above).

Non-local workers will be housed in the already-existing accommodation camps located outside the Sohar Port area and the Free Zone Area, inside the Project AoI. Worker spending is not foreseen to be significant on the basis that services such as accommodation camps, including dining facilities (e.g., a mess hall and kitchen), medical facilities, a laundry, recreation facilities, etc. are provided. The same existing accommodation camps will be used during all project phases (construction, operation, and decommissioning).

This impact is considered to be **Positive** and as such, a magnitude rating is not assigned.

8.6.1.4 Enhancement measures

Good international industry practice and operational management should be able to further enhance the potential positive local economy and employment impacts of the Project. The following enhancement measures will be implemented:

- An Industrial Baseline Survey (IBS) will be developed, including the following:
  - Local capacity and skills assessment including (but not limited to) the Wilayat of Sohar and Liwa;
  - Demand and supply-side analysis to identify which of the goods and services required for the Project could actually be sourced locally and in Oman;
  - Analysis on workforce capacity and capability and local procurement opportunities;
  - The IBS will also take into account findings from the Regulatory Study conducted for this Project in February 2018 which looks at Local Content and In-Country Value (ICV) requirements as well as any local content requirements enforced following 2018.

- Local Content Plan will be developed to inform the Project's in-country value planning, specifically, with respect to the employment potential for multiple positions and the local provisioning potential through local suppliers from the area, concretely:
  - As part of the tendering process, MARSA LNG LLC's contractors will be required to develop a purchasing strategy that stipulates how national and local purchase of goods will be optimised. The purchasing strategy will be required to adhere to all MARSA LNG LLC HSE policies and procedures. Agreed measures will be monitored and reported on. Motivation for the foreign import of materials and goods will be documented to illustrate why local alternatives were not used;
  - MARSA LNG LLC shall implement a phased capacity building programme that will enable local companies to achieve qualifications and potentially certification to the relevant standards and requirements well in advance of the tendering process;
  - MARSA LNG LLC shall engage with local government, industry and other organisations to determine opportunities for targeted training;
  - Any selected potential suppliers will have to meet health, safety and quality standards;
  - Following selection of primary contractors, the Project will carry out training of contractors on the Project HSE and socioeconomic and health policies prior to the start of construction;
  - The Project will work with local authorities and employment organisations to ensure that all positions are advertised in a manner that is accessible to the communities in the Social AoI. Unskilled workforce will be sources locally, to the extent possible (i.e. from Sohar and Liwa Wilayat);
  - The Project will ensure that the recruitment process is fair and transparent, public and open to all regardless of ethnicity, religion or gender;
  - The Project will agree an Employment Strategy with Primary Contractors that will include the expected level of local input for unskilled labour. Contractors will be required to attempt to source all unskilled labour from within Oman, and with best efforts to recruit unskilled labour as well as skilled labour to the extent possible from the communities of the Social AoI. Agreed measures will be monitored and reported on.
  - To facilitate access to employment opportunities for local candidates (within the wilayats of Liwa and Sohar) with appropriate skill sets, a database of people looking for work will be maintained and will identify the candidates' place of origin.
- The Stakeholder Engagement Plan developed for the Project will be regularly updated and will be implemented to outline how the Project will ensure regular, open and transparent communication with all stakeholders, concretely:
  - To provide clear information on the number and limited timescales of employment opportunities.
  - To ensure information on the employment and the procurement strategies is disclosed at all settlements within the Social AoI.
  - To plan an engagement with stakeholders through early, inclusive dialogue to build a shared understanding of the potential positive and negative impacts of workers influx, and the associated risks and opportunities.
  - Continuing to engage local people in the employment opportunities and work with suppliers to enable capacity building, procurement, employment and contracting opportunities in the communities, as part of maximizing the positive benefits.
- The Community Grievance Management Procedure described in the Stakeholder Engagement Plan will be implemented to ensure that stakeholders who have concerns or complaints about the

Project or wish to report their potential expectations or concerns related to local economy and employment can communicate directly with the Project.

8.6.1.5 Residual impacts

As per the Temporary direct and indirect employment opportunities (primary un-skilled), considering the adoption of the embedded controls inherent in the Project design and the proposed enhancement measures, employment opportunities will positively impact the community. Transparent hiring practices and clear information on employment opportunities will help to manage stakeholder expectations. Thus, the residual impact remains of **POSITIVE** significance.

As per the Temporary economic impacts from taxes and fees, procurement, and worker spending, considering payment of taxes will generate a long-term (project duration) impact, that the fees represent a small but significant amount of government revenue from a single project and that procurement will be enhanced through the proposed local content and procurement plan the residual impact remains of **POSITIVE** significance.

8.6.2 Workforce Social Issues – Workers Management (WM)

8.6.2.1 Impact Identification

This section presents the potential impacts to workforce social issues-workers management as a result of Project-related activity. This assessment addresses labour and working conditions and labour rights of the Project.

Workers' rights and labour working conditions need to be considered to avoid accidents and injuries, loss of man-hours, labour abuses and to ensure fair treatment, remuneration and working or living conditions. These issues should be considered not only for those who are directly employed by MARSA LNG LLC but also its contractors (including sub-contractors) and within the supply chain.

A series of mitigation measures have been designed to ensure that the level of impacts to workers is avoided, minimized or reduced.

Table 8-28 presents the key potential impacts of the Project workforce social issues-workers management. Further detailed assessment is carried out in the next subsections.

Table 8-28 Key Potential Impacts – Workforce Social Issues – Workers Management (WM)

Construction and Commissioning phase	Operation phase	Decommissioning phase
WM1 – Workers' Rights WM2- Child Labour in the supply chain WM3- Forced Labour in the supply chain	WM4 – Workers' Rights WM5- Child Labour in the supply chain WM6- Forced Labour in the supply chain	WM7 – Workers' Rights WM8- Child Labour in the supply chain WM9- Forced Labour in the supply chain

Source: ERM, 2020

8.6.2.2 Key Considerations

Box 8-13 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-13 Key Considerations for Assessment – Workforce Social Issues – Workers Management (WM)

Sources of Impact

- Use of contractors and subcontractors. During the main construction period, a maximum number of 1,800 workers will be employed by the Project directly and indirectly through contractors and subcontractors. During operation, this number will fall to approximately 120.
- The existing accommodation camps, to be used by the Project workforce, are located outside of the Sohar Port and Sohar Freezone. Services at the accommodation camps include dining facilities (e.g., a mess hall and kitchen), medical facilities, a laundry, recreation facilities, etc. The same existing accommodation camps will be used during all Project phases (construction, operation, and decommissioning).

Particular Baseline Conditions that Potentially Influence Impacts

- A Royal Decree issued on 8 July 2006 gives workers the right to form trade unions, whereas in the past only representation committees were allowed. This amended legislation eliminates the requirement to notify the government at least one month in advance of organizing meetings, as well as the requirement that all trade unions must write and speak in Arabic. The legislation also authorizes the creation of more than one union per company, which was prohibited before the 2006 Royal Decree was promulgated. Since then, few Trade Unions have been founded, including the national General Federation of Oman Trade Unions (GFOTU) in 2010.
- Despite the right to form trade unions, government control over the trade union activities remains high and there are still concerns within important sectors of the country's labour force, particularly migrant construction workers and the domestic work sector.
- Media articles reviewed as part of the 2023 Desktop Update indicated cases of physical and sexual abuse against domestic workers, mainly women as well as cases of Indian workers in the construction sector working without pay and living in poor conditions. According to several reports, migrant workers for example are at high risk of suffering human right abuses including exploitation by agencies and human trafficking under the visa-sponsorship employment system which grants recruitment agencies significant control over workers' residency and work visas and, therefore, their legal status in the country.
- As of July 2023, Oman had ratified four out of the eight fundamental ILO conventions. These include conventions No. 29 on forced labour and 105 on the elimination of forced labour, conventions No. 138 on minimum age and 182 on elimination of child labour. Oman has not ratified the conventions No. 100 on equal remuneration and 111 on non-discrimination, and conventions No. 87 on freedom of association and 98 on the right to organize and collective bargaining. The Royal Decree No. 35/2003, issuing the Labour Law covers general work parameters and regulations, including employment of citizens and foreign workers, employment contracts, wages, benefits and working hours, employment of juveniles and women, industrial safety, employment in mines and quarries, representative committees, disputes and penalties for employers or employees.
- Worker housing mainly consists in labour accommodation camps, and rented housing facilities. Rental worker housing in local settlements are typically shared apartments or villas, rooms, and farms that have been converted to housing facilities. Labour camps are established by contractors to accommodate their workers. Labour camps may take the form of permanent establishments (concrete buildings) or semi-permanent camps (containers or trailers). These are mostly located in Sohar area and in Falaj al Qaba'il specifically, as well as in Liwa further away from the Port. Labour camps are generally used by expatriate workers, as Omani workers from other areas prefer the rental option.
- For labour camps and commercial buildings, permits are issued after inspection by the health and environment ministries, the municipality and civil defence (PACDA) for hygiene and emergency response readiness. Inspections are conducted yearly to revalidate the license. The municipality also conducts random inspections. Housing conditions in labour camps vary between camps and contractors. It was reported that some of the semi-permanent camps (container or trailer camps) do not have air-conditioning and are poorly maintained. Usually, the camps managed by larger contractors offer better facilities, including clinics and canteens, but mostly in permanent camps (concrete buildings) such as the ODC compound (Figure) Palm Gardens (CB&I contractor), Dawood Complex, or Sohar Garden. Sohar Garden, the ODC compound and Dawood Complex

are located in Falaj al Qaba'il while Palm Gardens is located further away in Al Hambar neighbourhood of Sohar
- Internationally recognised worker conditions, health, safety, and environment standards for workers will be applied. These will include full-time doctors and paramedics employed to provide 24-hour medical cover by direct presence or on call.
- One of the main sources of abuse and exploitation of migrant workers is the constraining system of the kafala (sponsorship) visa system. This regulation is based on a condition of extreme dependence of the workers on their employers. As such, the employer constitutes the sponsor (kafeel) of the migrant worker to enter and reside in the country. Therefore, the worker cannot change jobs without his approval. These conditions facilitate exploitation and abusive working conditions.
- Despite laws prohibiting child labour, this practice continues to be present in sectors such as agriculture, fishing, and informal family businesses. It is also found in camel racing. Omani legislation does not contain prohibitive clauses on human trafficking, which aggravates the situation of migrants and leads to sexual exploitation. According to NCSI, Muscat and Al Batinah North governorate accounted for 69% of the observed cases of child abuse.

Project Factors that Potentially Influence Impacts

- The LNG Plant Construction Activities are expected to last about 34 months including commissioning and pre-commissioning.
- Once commissioned, the operational activities and maintenance activities will start at the LNG Site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- The workforce will consist of approximately 70% of expatriates, considered a vulnerable group since these individuals will not enjoy the same level of benefits that Omanis do.
- The current standards and practices of Omani companies in regard to migrant workers may fall short of international standards in terms of workers' rights.

Relevant existing Controls/Mitigations

- Hazardous and special waste generated during construction/commissioning activities will be stored and secured. Such wastes will be segregated for collection and disposal by specialist contractors at equipped and approved sites.
- Internationally recognised standards for worker Health Safety and Environment will be applied. These include full-time doctors and paramedics employed to provide 24-hour medical cover. In addition, the MARSA LNG LLC standard GS EP SAF 521 related to safety specific requirements for LNG onshore liquefaction plants and export will be applied.
- MARSA LNG LLC Code of Conduct will be applied. EPC Contractor will apply MARSA LNG LLC's Code of Conduct.
- MARSA LNG LLC's human rights internal guides state the importance for MARSA LNG LLC and its suppliers and contractors to pay special attention to employees' working conditions, respect for individuals and their privacy, a discrimination-free environment and health and safety, irrespective of the political and social context or any complexities encountered. The Project will apply its Code of Conduct over the full supply chain.

The following subsections present the impact evaluation during the three project phases (Construction and Commissioning phase; operations phase and decommissioning phase).

8.6.2.3 Impact Assessment

Construction and Commissioning, Operations and Decommissioning

WM 1,4,7 – Labour and Working Conditions/Workers' Rights

The composition of the workforce will include approximately 1,260 expatriate workers during construction and 84 during operation. Recruitment of labour for the Project will be carried out within the framework of the Omani Labour Code, and the laws and statutes in force on hiring public services in Oman. These include respect for freedom of association, no forced labour, the minimum age of employment and the rights of children and adolescents. However, in practice working conditions and labour rights in Oman may not be fully respected. Under the Omani Law, expatriate population do not benefit from the same employment conditions as Omanis. The '*Kafala*' system (or visa sponsorship system) could lead to potential abuses including erratic or reduced payment of wages, passport confiscation, workers entering employment with high levels of debt bondage and pay levels below those agreed when workers were recruited in their home countries as well as harassment and sexual abuse mainly in the cases of domestic employment.

Housing standards established by the Ministry of Housing apply to residential housing, including rental housing for workers. However, in some cases rental worker accommodation is not licensed and therefore does not meet the required standards. Although, ministry standards for residential housing do not apply to labour camps, these still need to pass inspection by the health and environment ministries, the municipality and civil defence (PACDA) for hygiene and emergency response readiness. Labour camps are generally used by expatriate workers, as Omani workers from other areas prefer the rental option.

The Project will need to establish robust measures to ensure improved respect for worker rights while keeping in mind the national context as potential sources of abuse and exploitation could arise. However, the measures incorporated into the Project provide labour safeguards. Specifically, MARSA LNG LLC has a strict human rights policy, covering worker welfare conditions, that is binding for all of its contractors and subcontractors.

Lower skilled expatriate labour may be highly vulnerable and dependent on adequate systems of worker welfare established by their employers. Downsizing during the operation phase also poses a risk of poor termination conditions.

As stated in the Social Baseline, with respect to working conditions, unpaid or delayed wages and excessive working hours without pay were the main concerns reported by workers in the Port area. Unpaid or late salaries are recurring issues. It was reported that most common complaints have to do with delays in salary payments, sometimes by 2 to 3 months while the legally allowed maximum delay is 19 days. Failure to pay wages on time also means that some workers may not be able to reimburse their recruitment fees or pay their sponsors on time which may lead to situations of indebtedness that enhance abusive relationships between the workers and their sponsors. Workers also claim to often be forced to work overtime without pay.

During all Project phases (construction, operation and decommissioning) employees will use the same accommodation camps located at the Freezone Port Area. Living conditions during all Project phases should conform to international best practice.

As a result of the policies and procedural safeguards regarding MARSA LNG LLC standards, the magnitude of the impact is deemed **small**. However, the receptors' sensitivity is **high** as expatriate workers are considered a vulnerable group since these individuals will not enjoy the same level of benefits that Omanis do. Also, issues with implementation and capacity may result in some breaches of workers' rights especially within the supply chain and amongst casual labourers. Thus, the impact significance is **MODERATE**.

Potential impact descriptors for WM1,4,7							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	HIGH	**Moderate**

WM 2,5,8 – Child Labour in the supply chain

There is the potential that nationally based subcontractors and suppliers (who may form part of the supply chain) could have child labour in their operations or be employing people under 18 years to undertake activities for the food, maintenance or aggregates services. This is a particular risk in companies where the use of informal and day workers is more prevalent.

The use of child labour is likely to have negative impacts on the health and wellbeing (mental health) of affected children including on their access to education and social development as well as the child's right not to work in certain circumstances.

The potential impact to sensitive receptors is of **small** magnitude as MARSA LNG LLC contractual requirements, Human Rights policy and penalties for use of child labour are expected to minimise this risk. However, there is still potential for child labour or use of people aged 16-18 to be involved in the supply chain. The receptor sensitivity is **high** as in case child labour were to be used, it is likely to have negative effects on the affected children's health and wellbeing. As such, the impact significance is **MODERATE**.

Potential impact descriptors for WM 2,5,8							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	HIGH	**Moderate**

WM3,6,9 – Forced Labour in the supply chain

The construction and operation activities may increase the risk of forced labour as understood by the ILO in the sense of unpaid or low wage compulsory work and overtime. Should forced labour be used, this is likely to impact the physical and mental health and wellbeing of the affected individuals as well as their right not to be forced to work.

There is a strong divide between Omani labour (which is well supported by Government Policies and agencies) and expatriate labour (which is much more vulnerable to exploitation because they are less well represented by the system), and in many cases expatriate workers do not know their rights or have limited access to support systems. One of the main sources of abuse and exploitation of migrant workers is the constraining system of the *kafala* (sponsorship) visa system whereby the employer constitutes the sponsor ('*kafeel*') of the expatriate worker to enter and reside in the country.

Workers have little or no means of protection and redress and are at risk of imprisonment and deportation, even when fleeing exploitation or abuse. Frequent abuses include debt bondage due to very high recruitment fees that have to be paid to an agent or labour broker; the confiscation of workers' passports despite a legal prohibition to do so; failure to pay their wages in full or at all; working excessive hours without overtime payment, breaks, or days off; denial of adequate food and living conditions; harassment and abuse, including sexual abuse. Note that skilled or semi-skilled workers are more likely to know their rights, be of higher socioeconomic status and therefore less likely to become forced labourers.

The potential Impact to sensitive receptors is **small** magnitude as MARSA LNG LLC contractual requirements and penalties for use of forced labour should minimise risk. The receptor sensitivity is **high** as these workers are a vulnerable group and forced labour could trigger negative effects on the physical and mental health and wellbeing of the affected individuals. The impact significance is **MODERATE**.

Potential impact descriptors for WM3,6,9							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	HIGH	**Moderate**

8.6.2.4 Mitigation measures

Good international industry practice and operational management should be able to greatly reduce the potential impact of the Project. The following mitigation or preventive measures will be implemented:

- The Project will develop an Occupational Health and Safety (OHS) Plan, as part of a Health and Safety Management System. The OHS Plan will comply with the requirements of the Ministerial Decision No. 286/2008. In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, a Hazard Identification Study (HAZID) will be developed in order to inform the Health and Safety management system. This management system will be enforced throughout the Project and will be applicable to all Project personnel (including direct hire employees, advisors and consultants, contractors and sub-contractor personnel). It will include aspects such as regular training and monitoring, as well as monitoring, inspection and audit. The following measures will be included:
  - MARSA LNG LLC will assess the potential for injury or risk of accident and will take into account prevailing environmental conditions at the site location, including the potential for extreme natural hazards such as earthquakes or hurricanes. All employees have the duty to stop any works if adequate systems to control risks are not in place.
  - MARSA LNG LLC will verify the results of the risk assessments with respect to potential hazards, aspects and impacts, and whether the necessary control measures are implemented.
  - Employees should not be under the influence of intoxicants, which could adversely affect the ability of that EMPLOYEE to perform the work or adversely affect the health and safety of other Employees, other persons or the environment.
  - Surveillance programs for health status shall be established and implemented. In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, a health and safety committee will be established. Its duties will be training, monitoring as well as safety checks and audits.
  - Health and safety induction/training including fire safety training, emergency response procedures and LNG hazards (chemical, cold surfaces) will be provided to all employees (MARSA LNG LLC, contractors and subcontractors).
  - As part of the contractor and supplier selection process, MARSA LNG LLC will take into consideration the suppliers' performance regarding worker health and safety as outlined in Omani law and policies, and in international standards.
  - In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, the Project will provide regular medical check-ups and centralized medical assistance for all workers (MARSA LNG LLC, contractors and subcontractors).
  - Contractor contracts will establish the right for Omani Government monitoring and auditing of all contractors and subcontractors and the consequences for the contractor if they are found to be breaching national legal requirements, international standards, MARSA LNG LLC's

policies or clauses in the contract. Contractor contracts will specify that the same standards will be met by their sub-contractors and suppliers.

  - Workers and sub-contractors will be provided with the means to ensure compliance such as information, instruction and training, work equipment and personal protective equipment (PPE). Training includes identification of potential hazards to workers, particularly those that may be life-threatening, as well as training in preventative and protective measures, including modification, substitution, or elimination of hazardous conditions or substances.
  - In accordance with MARSA LNG LLC's minimum requirements and the outcomes of the contract-specific risk assessment, appointed contractors are required to provide appropriate welfare facilities, first aid facilities and health assistance and ensure that trained personnel are present on site. Such provisions will be established at worksites prior to the start of any mobilization of the workforce. Any appointed contractors will establish their own Emergency Response Plan and communicate key information to the Project workforce prior to work commencing on any site.
  - A formal Permit to Work (PTW) system will be developed for the facilities. The PTW will ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out, including hazards involved, and safe isolation procedures to be followed before commencing work. A lockout/tagout procedure for equipment will be implemented to ensure that all equipment is isolated from energy sources prior to maintenance or removal.

- A Workers Management Plan will be developed (including workers accommodation) considering the following elements:
  - No employee or job applicant will be discriminated against on the basis of their gender, marital status, nationality, age, religion or sexual orientation;
  - All workers will, as part of their induction, receive training on worker rights in line with Omani legislation and Company Standards to ensure that positive benefits around understanding labour rights are enhanced;
  - All workers (including those of contractors and subcontractors) will be able to join unions of their choice and have the right to collective bargaining;
  - All workers (including those of contractors and subcontractors) will have contracts which clearly state the terms and conditions of their employment and their legal rights;
  - Contracts will be verbally explained to all workers, in a language they understand, where this is necessary to ensure that workers understand their rights;
  - Contracts must be in place prior to workers leaving their home location stipulating working hours, pay, and other terms of employment;
  - Contractor contracts will establish the right for MARSA LNG LLC monitoring and auditing of all contractors and subcontractors and the consequences for the contractor if they are found to be breaching national legal requirements, international standards, MARSA LNG LLC's policies or clauses in the contract. Contractor contracts will specify that the same standards will be met by their sub-contractors and suppliers;
  - MARSA LNG LLC and Contractors' will implement a program of socioeconomic compliance monitoring to inform internal auditing and monitoring process. As such, KPIs will be developed around worker rights, discrimination and management, workforce grievance mechanism and monitoring of outcomes. As part of the contractor and supplier selection process, MARSA LNG LLC will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in Omani law and ILO international standards;

- As part of the contractor and supplier selection process MARSA LNG LLC will take into consideration performance with regard to worker management and rights as outlined in Omani law, international standards and MARSA LNG LLC's policies;
- MARSA LNG LLC will oversee if suppliers comply with all applicable child labour laws and only employ workers who meet the applicable minimum legal age requirement in accordance with international standards;
- MARSA LNG LLC will review and monitor the outcomes of community engagement, media coverage and its workforce and community grievance mechanism for additional indications of labour-related issues that may be arising;
- MARSA LNG LLC will develop a Human Resources Policy which will outline worker rights to be included in all contracts including restrictions on working hours in line with Omani and international law, compensation including consideration of overtime, holidays etc. MARSA LNG LLC will require its contractors and subcontractors to put in place policies in line with national legislation and international regulations; and
- A Labour Rights Assessment to inform the development of the Workers Management Plan will be developed considering the sensitivities of expatriate workers in Oman to better understand labour welfare and associated social risks.

- A Worker Grievance Mechanism (WGM) will be developed:
  - MARSA LNG LLC will put in place and will require all contractors and sub-contractors to put in place a worker grievance mechanism that will be accessible to all workers, whether permanent or temporary, directly or indirectly employed.
  - The Grievance Mechanism should be:[132]
    - Legitimate: should be a clear, transparent and equitable process that is designed and implemented in accordance with the effectiveness principles, and which should encourage trust.
    - Accessible: the procedures for using a WGM should be kept as simple as possible, avoiding unnecessary administrative stages. All workers should be informed about the grievance mechanism at the time they are hired.
    - Predictable: Management should provide a clear and known procedure for using the WGM, together with an indicative time frame for each stage.
    - Equitable: Workers and management should have reasonable access to sources of information, advice and expertise necessary to engage in a grievance process on fair and informed terms. Where there are language barriers, it may be necessary to provide written materials in different languages and to engage interpreters.
    - Transparent: Every complaint should be treated seriously, and dealt with consistently and in an impartial, confidential and transparent manner. This builds the credibility of the mechanism among workers and ensures that it will be used.
    - Rights-compatible: Outcomes and remedies should be in line with internationally-recognized human rights legislation, MARSA LNG LLC Standards and national law.
    - Based on engagement and dialogue with stakeholders: Engaging with workers on the design and performance of a grievance mechanism can help to confirm that it meets their needs, that they will use it in practice, and that there is a shared interest in its success.
  - The MARSA LNG LLC worker grievance mechanism shall be open to the contractor and subcontractor workforce in the event that their grievance is not adequately resolved by their

[132] Adapted from IPECA Worker Grievance Mechanisms: Guidance document for the oil and gas industry.

direct employer. MARSA LNG LLC will then have the authority to act to resolve this grievance.

- The Project Stakeholder Engagement Plan will be regularly updated and will include continuous engagement throughout the Project lifecycle with the Omani Trade Union and other key stakeholders including worker representatives.

8.6.2.5 Residual impacts

As per the Labour and Working Conditions/Workers' Rights impact, as a result of the policies and procedures stated as mitigation measures, workers' rights should be protected. If issues arise, there will be identified and addressed through the worker grievance mechanism. Thus, the scale of the impact is minimized and the residual impact is considered of **MINOR** significance.

Potential impact descriptors for WM1,4,7							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

As per the Child labour impact, the contractual requirements and penalties for use of child labour should significantly minimise the scale of the risk. The grievance mechanism and audit processes are assumed to pick up any instances of child labour. The residual impact is considered of **MINOR** significance.

Potential impact descriptors for WM2,5,8							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

As per the Forced labour impact, the likelihood and scale of the use of forced labour will be significantly reduced as a result of the proposed mitigation such that it will become a non-routine event. However, should incidences occur, the impacts on the individuals affected will remain unchanged. The residual impact is considered of **MINOR** significance.

Potential impact descriptors for WM3,6,9							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

8.6.3 Community Health, Safety and Security (CHSS)

8.6.3.1 Impact Identification

This section presents the potential impacts to community health, safety and security (CHSS) as a result of Project related activity. In addition to the commitments made by MARSA LNG LLC, a series of mitigation measures have been designed to ensure that the level of impacts to socioeconomic receptors is avoided, minimised or reduced.

Table 8-29 presents the key potential impacts of the Project CHSS. Further detailed assessment is carried out in the next subsections.

Table 8-29 Key Potential Impacts – Community Health, Safety and Security

Construction and Commissioning phase	Operation phase	Decommissioning phase
CHSS1 – Safety Risks due to Increased Marine Traffic and vessel collisions CHSS2–- Impacts on Environmental Health–- Air Quality degradation CHSS3–- Increased transmission of communicable diseases CHSS4–- Increased pressure on health care	CHSS5–- Safety Risks due to Increased Marine Traffic and vessel collisions CHSS6–- Impacts on Environmental Health–- Air Quality degradation CHSS7- Increased transmission of communicable diseases CHSS8- Increased pressure on health care	CHSS9- Increased transmission of communicable diseases CHSS10- Increased pressure on health care

8.6.3.2 Key Considerations

Box 8-14 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-14 Key Considerations for Assessment–- Community Health, Safety and Security

Sources of Impact

- Construction: A number of vessels will be required to deliver equipment, piping and material needed for the plant construction.
- Operations: Vessel traffic will depend on the LNG market request. The following scenarios can be considered as base case: (a) LNG Export Carrier: 15 offloading/year (in case of no bunkering demand) or (b) LNG Bunker Vessel: 1 offloading/day (in case bunkering demand consumes all production). Consequently, maximum vessel traffic associated to the LNG terminal operation is one vessel per day.
- Presence of the construction workforce of maximum 1,800 people sourced nationally and internationally and approximately 120 people for operations.
- Internationally recognised labour and working conditions, health, safety, and environment standards for workers will be applied. These will include full-time doctors and paramedics employed to provide 24-hour medical cover by direct presence or on call. Accommodation camps will also have their own medical facilities.
- Communities and stakeholders concerns were related to safety once the LNG Plant it is operational.
- Changes to the environment due to increased noise, decreased air quality and changes to the visual environment as a result of the Project may affect health and wellbeing.
- Exposure to activities of Project security personnel.
- Movement of vehicles, equipment, personnel and supplies.
- Presence of workers in the surrounding areas.

Particular Baseline Conditions that Potentially Influence Impacts

- There were 3,192 vessels calls in Sohar Port in 2022, increasing from 3,000 in 2020 but declining compared to 3,434 vessels call in 2018.[133]
- The construction of the Sohar Port in the early 2000s in the Wilaya of Liwa resulted in the loss of fishing grounds corresponding to the Port's concession and exclusion zone (3 km into the sea and 7 km wide), as well as fishing grounds along the beach in the nearshore area where the Port was built.
- Enforcement of the exclusion zone is overseen by the Sohar Port in collaboration with the Royal Omani Police (ROP). Fishermen that enter the port's exclusion zone are immediately removed by the ROP and fined.
- Fishing as the primary livelihood activity in the AoI has been declining since the late 1980s and even more so since the establishment of the Port in the early 2000s. The general perception is that a combination of factors including loss of fishing grounds and access to sea, environmental pollution, and overfishing / illegal fishing practices have contributed to this decline. However, the establishment of the Port and industrial activities within the Port are viewed by stakeholders as the main causes of loss of fishing grounds and pollution.
- In offshore areas, the Batinah sea is attached to the Batinah north and south governorates and is accessible to all fishermen of the governorates. Fishermen can also go into international waters mainly for tuna fishing. Fishing activities used to be focused primarily on nearshore fishing; however, with increasing restrictions and loss of fishing grounds more fishermen are investing in boats that allow them to fish further offshore. Statistics on offshore fishing by local fishermen are not available. In the near shore, fishermen have formal ownership claims over traditional fishing grounds called *shudood* (or '*shad*' in singular) consisting of purpose-built artificial reefs to enhance fish catch.
- Fishing communities in the AoI that depend on fishing activities for income generation and household consumption are considered to be a vulnerable group. These households are characterised by lower incomes and reduced access to savings or credit, high dependency ratios or low literacy rates and education attainment levels associated to youth. For fishing communities, although most households have supplemental livelihoods, fishing still contributes the major portion of their income.
- No incidents of collisions between fishing boats and larger vessels in the exclusion zone were reported except for a one-time incident when a broken fishing boat drifted into the exclusion zone and collided with a vessel.
- There are no settlements within 2 km of the LNG.
- Local communities and local community representatives have reported noticeable increases in pulmonary cancers, respiratory illnesses such asthma, skin allergies, and miscarriages in the past 10 years and have associated these increases with environmental risk factors related to the industrial activity in the area, in particular air quality.
- Oman has made significant progress in reducing mortality and disability rates for communicable diseases, and the overall trend continues to be downwards for incidence of these diseases. Based on data from the Ministry of Health in 2017, mortality rates for infectious diseases, respiratory system, and genitourinary systems are higher in Al-Batinah North than in Oman as a whole.
- The mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease among the age group (30-70) years per 100,000 population in Oman was 122.6 in 2020 compared to 138.7 in 2017.[134]
- Among communicable diseases, although airborne infections are the main cause for inpatient morbidity (9.3%), the number of episodes dropped from 83 (11.6%) per 10,000 population in 2019 to 45 (9.3%) in 2020. The overall communicable diseases decreased from 111 (15.5%) per 10,000 population in 2019 to 58 (11.8%) in 2020. [135]
- The non-communicable diseases have also decreased from 294 (41.1%) per 10,000 population in 2019 to 185 (37.8%) in 2020. Diseases of respiratory system have decreased to 9 (1.9%) per 10,000 population in 2020 compared to 18 (2.5%) in 2019.

[133] Sohar Port and Freezone, available at SOHAR Port and Freezone and accessed on 8 August 2023

[134] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

[135] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

- Sexually transmitted infections (STIs) are a significant public health problem world-wide, especially in developing countries (Oman has a large ex-pat community which includes people from developing countries who have come to Oman looking for work). With the exception of HIV, STI surveillance has been neglected, resulting in insufficient data on the global prevalence of STIs. The Ministry of Health reports that STIs in Oman are on the rise, although this may be due in part to increasing awareness of the need for diagnosis and treatment (Ministry of Health 2014). In 2020, there were 147 cases of HIV among Omani nationals registered in the Ministry of Health, indicating a decreased of 15.5% compared to 2019; 80% of the cases recorded referred to males. The number of new HIV infections per 1,000 uninfected population was 0.02 for women and 0.05 for men in 2020, dropping from 0.03 for women and 0.06 for men in 2019.[136]
- The national-level mortality rate attributed to household and ambient air pollution was 14.1 per 100,000 population in 2020 compared to 11.9 in 2019, 10.9 in 2018 and 6.9 in 2016.[137]
- The national-level mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene was 0.01 per 100,000 population in 2020 compared to 0.02 in 2019 and 0.04 in 2017. [138]
- Approximately 26.6% of male teenagers and 3.6% of women teenagers smoked as of 2020. This highest percentage of teenager women smokers was recorded in North Al Batinah (52.6%) in 2020. Approximately 6.6% of male teenagers and 2.2% of women teenagers consumed alcohol as of 2020.[139]
- Prevalence of obesity was 19.1% in total at national level in 2020 but it affected women more than men (15.6% for male and 22.3% for females).
- Contraceptive prevalence was 28% among urban women and 16% among rural women in 2020.
- At the AoI level, there is one public health centre in Falaj Al Qaba'il, which provides primary care services (level 1) to all three settlements of Majis, Al Khuwairiya, and Falaj al Qaba'il. There is also one health centre in Liwa and a public clinic. These centres are reportedly under increasing pressure due to the growing population in the area. Most industries in Sohar industrial zone have their own occupational healthcare facilities that are well equipped and take care of on-site health issues and injuries.

Project Factors that Potentially Influence Impacts

- The LNG Plant Construction Activities are expected to last about 34 months including commissioning and pre-commissioning.
- Once commissioned, the operational activities and maintenance activities will start at the LNG Site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- Most of the workers involved in the construction will be accommodated in existing camps located outside but nearby the port area. Services at the accommodation camps include dining facilities (e.g., a mess hall and kitchen), medical facilities, a laundry, recreation facilities, etc. The same existing accommodation camps will be used during all project phases (construction, operation and decommissioning).

Relevant existing Controls/Mitigations

- Marine exclusion zones within the SIPC Concession Area.
- Navtec Notice to Mariners
- Internationally recognised standards for worker Health Safety and Environment will be applied. In addition, the MARSA LNG LLC standard GS EP SAF 521 related to safety specific requirements for LNG onshore liquefaction plants and export will be applied.
- After construction activities, and during operations, the LNG site and the onshore facilities will be permanently fenced due to security and safety issues, following MARSA LNG LLC HSE standards.
- In the case of complaints regarding destruction of fishing equipment or collisions outside the exclusion zone, SIPC refers the matter to the Ministry of Fisheries for an initial review and screening before addressing the issue. The first screening by the Ministry consists in reviewing the

[136] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023
[137] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023
[138] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023
[139] 2020 Annual Health Report, available at Binder1.pdf, page 1-564 @ HotFolder (moh.gov.om), accessed on 29 July 2023

complainant's fishing and boat license to assess whether the fisherman was fishing in an area he is authorized to fish in and with the authorized fishing gear, fishing season, etc.

8.6.3.3 Impact Assessment

Construction and Commissioning, Operations and Decommissioning

CHSS1,5- Safety Risks due to Increased Marine Traffic and Vessel Collisions

Potential disruption to marine navigation (including fisheries) and related safety risks in the SIPC port Concession Area would be due to an increase in marine vessels as a result of the presence of Project vessels during construction and the tankers and vessels expected to arrive and depart from the Jetty during all phases (construction, operations and decommissioning).

Transit along the SIPC port Concession Area is forbidden for safety reasons. However, there has been a certain margin of tolerance for the passage of fishing vessels on very specific occasions. Enforcement within the overall SIPC Concession area is overseen by the Sohar Port in collaboration with the Royal Omani Police (ROP). Normally, fishermen that enter the port's SIPC Concession area are immediately removed by the ROP and fined. Figure 6-13 in Section 6.9.1.5 shows the SIPC Concession Area.

The co-existence of fishing vessels and large vessels both near and offshore results in an increased marine traffic and potential for interaction between fishing boats and larger vessels, which could result in risk of collision and damage to fishing equipment and gear. Project vessel movements will add to existing port-related navigation and shipping traffic in the AoI, potentially increasing marine traffic safety risks. However, the number of vessels involved in the construction phase is very low and during operations it will be a maximum of 1 vessel per day during operations. Thus, the traffic related to the project would contribute to a very small percentage of increase in traffic in the port area.

In the case of complaints regarding destruction of fishing equipment or collisions outside the SIPC Concession area, SIPC refers the matter to the Ministry of Fisheries for an initial review and screening before addressing the issue. The first screening by the Ministry consists in reviewing the complainant's fishing and boat license to assess whether the fisherman was fishing in an area he is authorized to fish in and with the authorized fishing gear, fishing season, etc.

Based on discussions with fishermen in Harmul and Liwa in 2019, only one incident was reported where a fishing boat collided with a vessel. The fishing boat was reportedly unoperated and drifted into the restricted area where it collided with a vessel. SIPC has reportedly conducted safety awareness sessions with fishermen in collaboration with the Ministry of Fisheries, however fishing in the exclusion zone still occurs despite the risks. Fishermen caught fishing in the exclusion zone are immediately removed by the ROP coast guards and fined.

Considering the already existent port-related marine traffic, the frequency and number of vessels related to Project activities which is expected to increase port related traffic in approximately 5% during operation and the fishing carried out offshore, the magnitude of the impact and the sensitivity receptor is deemed to be **medium**. The impact significance is **MODERATE**.

Potential impact descriptors for CHSS1,5							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	MEDIUM	MEDIUM	**Moderate**

CHSS2,6- Impacts on Environmental Health - Air Quality degradation

Studies conducted in the area have shown increased cases of respiratory and allergic diseases associated with air quality in the AoI; however, the cause-and-effect relationship between industrial activity and health incidences was not clearly established. In contrast, air quality monitoring data collected by the Ministry of Environment are reportedly within standards limits, and a comparative study of health incidences in Liwa and Khaboura (further away) conducted by the Ministry of Health did not show any differences, although the study itself was not shared with the team of consultants. Pollutant concentrations have generally been maintained in the same order of magnitude: slightly increasing values for CO, O_3, SO_2 and PM_{10} have been monitored in 2020, but then decreased in 2021. A slightly decreasing trend is monitored also for NO_2 and NMHC. See Sections 4.1.5 and 8.5.1 for further detail.

In any case, distrust and lack of transparency regarding environmental health issues and the perceived impact of port activities was clearly stressed by local communities and sheikhs during field survey baseline data collection. This constitutes a clear point of contention and social risk for the Project, especially considering that complaints about air quality degradation, odour, and dust contributed to the build up towards local unrest in the 2011 and 2012 in the area.

As specified in Section 8.5.1, construction activities are likely to generate low amounts of emissions locally and intermittently over a temporary period (~34 months) from both mobile (i.e. vehicles) and stationary (i.e. generators) sources. During start-up and normal operations phase, Project emissions are modelled to be well below the national air quality standards. NO_2, SO_2 and CO modelled concentrations comply at all assessed receptors with the IFC Environmental, Health, and Safety (EHS) Guidelines 2007. The same is not true for PM_{10}, due to local airshed currently degraded with the PM_{10} baseline annual concentration equal to 134.30 µg/m^3; this results in a negligible increase in air pollutants compared to the current baseline conditions. The maximum concentration levels are confined within the LNG site whilst the closest receptors are located more than 2 km far from the LNG, which is sufficiently far to not be reached by significant concentrations of the modelled pollutants (see Appendix C for further details). Thus, the sensitivity of the receptors is **medium**. Considering the relative long-term duration of the impact both during construction and operations, the magnitude of the impact is considered **medium.** However, it is still important considering the industrial nature of the area and potential cumulative air quality impacts of the Project to nearby settlements. Overall, the significance of the impact is **moderate.**

Potential impact descriptors for CHSS2,6							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Long-term	Temporary	Local	MEDIUM	MEDIUM	**Moderate**

CHSS3,7,9- Increased transmission of communicable diseases

Population shifts caused by the influx of workers from other parts of the country or from foreign countries have the potential to cause changes in transmission patterns of some communicable diseases, particularly if workers originate from countries with higher rates of diseases that are transmitted person-to-person, such as TB and sexually transmitted infections. This is a particular risk in relation to communities close to construction where the potential for interaction is highest. Although the impact is expected to be present during all phases of the Project, it is during construction that it is expected to be greatest due to the large influx of workers.

These diseases will be influenced by the disease profiles of (1) the local communities, and (2) the countries of origin of the workers. Communicable diseases are infectious diseases that can be transmitted from one individual to another either directly by contact or indirectly by vectors.

Communicable diseases of concern are likely to include tuberculosis, hepatitis A, B and C, diarrhoeal diseases, acute respiratory infections and STDs. The workplace is considered an important setting for interventions for the prevention and control of infections.

Housing conditions in labour camps vary between camps and contractors. It was reported that some of the container camps in the AoI do not have air-conditioning and are poorly maintained. With respect to hygiene, field survey discussions with local government stakeholders have highlighted an increase in the risk factors for infectious diseases associated with hygiene. These had to do in particular with the presence of non-licensed farms being used as rental accommodation for expatriate workers, and with the increasing presence of rats brought into the Port through ship containers.

The presence of an external workforce living in rented housing facilities in the AoI has the potential to lead to the increase in sexually transmitted diseases due to the potential for worker community interactions. This is a particular risk in relation to communities close to the residences where the potential for interaction is highest.

The presence of expatriate workforce was highlighted by the stakeholders as a prevalent issue in the area, especially with respect to the movement of low-skilled labour in large numbers and accommodation within the local communities. Related complaints have to do with the involvement of expatriate workers with domestic labour employed in local households in the communities.

Considering the project embedded controls, the magnitude of the impact is considered medium and the receptor's sensitivity **medium**. Therefore, the impact is considered of **MODERATE** significance.

Potential impact descriptors for CHSS3,7,9							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	MEDIUM	MEDIUM	**Moderate**

CHSS4,8,10- Increased pressure on health care

At the AoI level, there is one public health centre in Falaj Al Qaba'il, which provides primary care services to all three settlements of Majis, Al Khuwairiya, and Falaj al Qaba'il, and one health centre in Liwa. These centres are reportedly under increasing pressure due to the growing population in the area, especially with the presence of Omani nationals from other regions who have equal access to public health facilities. In contrast, most expatriate workers have access to healthcare services through their employer (in the camps or onsite) and attend private clinics and hospitals; however, some workers who do not get health insurance coverage tend to go to the local health centres.

Although normally only locals go to local hospitals and health centres, the influx of 1,800 workers for the construction phase entails an increase in the provision of health care services to workers (both primary and secondary) and can affect communities' access to health care services. Any decrease in access to health care facilities, including increased waiting times, is likely to be associated with a worsening of health outcomes. This is a particular risk in the case of incidents involving multiple victims or patients from both the workforce and the community, when care is required at the hospital level or in the case of a disease epidemic.

Note that pressure on services such as sanitation and waste are not expected to be an issue as government infrastructure tends to be well designated with sufficient capacity for population growth.

Considering the project embedded controls related to offering medical healthcare in camps and at construction site, the magnitude of the impact is considered **medium** and the receptor's sensitivity **medium**. Therefore, the impact is considered as of **MODERATE** significance.

Potential impact descriptors for CHSS4,8,10							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	MEDIUM	MEDIUM	**Moderate**

8.6.3.4 Mitigation measures

Good international industry practice and operational management should be able to greatly reduce the potential impact of the Project. The following mitigation or preventive measures will be implemented:

- A Workers Management Plan will be developed, including:
  - The implementation of a Workforce Code of Conduct and measures for living and working conditions which will contribute to reduce the risks of diseases transmissions into the community and a worker grievance mechanism. The Code of Conduct shall expressly prohibit sexual interactions of any kind with underage persons.
  - The Contractor will regularly monitor interactions between the community and workers both in public spaces in the communities and in private spaces, where vulnerable people have the greatest potential for abuse, especially children and young women.
  - Workforce (including subcontractors) will be provided with health awareness training, including a significant briefing of hygiene practices (such as hand washing), implementation of educational outreach to increase awareness of major communicable disease and how to protect against infection and about transmission routes and the symptoms of the communicable diseases of concerns (including STDs).
  - Conduct pre-employment screening protocols for all employees including contractors and subcontractors which will include testing for TB and other diseases appropriate to the individual's country of origin (e.g. hepatitis, acute respiratory diseases) and vaccinations.
  - Workers will be provided with primary health care and basic first aid at worksites. Additionally, MARSA LNG LLC will define designated Project medical professionals in selected medical clinics in the AoI.
  - Regular medical check-ups and centralized medical treatment for all workers of the Project (MARSA LNG LLC, contractors and subcontractors) will be provided.
  - MARSA LNG LLC and its contractors and subcontractors will as part of the induction process provide consistent training and education to all workers to ensure awareness of transmission routes and methods of prevention of STDs and other diseases of concern such as TB as well as early symptoms of such diseases.
  - MARSA LNG LLC contractors and sub-contractors will provide cultural sensitivity training to remind workers they need to be sensitive of local women, norms and customs.

- A Community Health and Safety Management Plan (CHSMP) will be developed, including the following health issues:
  - MARSA LNG LLC will undertake a health facility assessment of medical infrastructure within the Sohar area as part of the Health and Safety Management System to determine if facilities have sufficient resources and equipment to deal with emergencies. Agreements will be entered into with suitable hospitals to provide health care in emergency situations. These agreements will include provision of additional equipment or training for staff if required by MARSA LNG LLC. Project-dedicated international medical providers to complement the services of the local medical facilities that could be utilized by the Project and/or training of local medical personnel.
  - In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, MARSA LNG LLC will develop Emergency Response Plans (ERPs) taking into account access to health care, major incidences, multiple casualty events and

pandemics. Ship traffic, including at loading and unloading jetties, associated with LNG facilities should be considered, with respect to local marine traffic patterns and activities. These should be developed in consultation with national emergency providers and local health care facilities and will cover all contractors and subcontractors as well as consideration of the local community.
  - MARSA LNG LLC will monitor the emergence of major pandemics through WHO alerts. When the WHO Pandemic Alert Scale reaches Level 4 MARSA LNG LLC will implement the relevant ERPs.

- The Traffic Management Plan (see Section 8.6.4.4) will also include:
  - Any trucking companies employed to work on the Project will have policies around health screening of their workers in line with Project requirements;
  - MARSA LNG LLC Contractors & Subcontractors will ensure that all truck drivers who will work on site receive the training on worker code of conduct and disease awareness training; and
  - At the site perimeter, MARSA LNG LLC EPC Contractor will review routes and journey plans for the truckers, including likely stopping points or rest stops. MARSA LNG LLC EPC Contractor will provide details of the grievance mechanism at these locations;

- A Stakeholder Engagement will be developed and regularly updated to include the following commitments:
  - MARSA LNG LLC will undertake a programme of stakeholder engagement and consultation through the Local Stakeholder Committee to educate local communities of the risks of trespassing onto sites, the meaning of signs and the dangers of playing on or near equipment or entering fenced areas. This will include presenting in every primary and secondary school in communities. Records of the meeting and attendees should be kept;
  - MARSA LNG LLC will undertake stakeholder engagement with potentially affected communities and other stakeholders on a range of issues including changes to the visual environment, noise and socioeconomic concerns;
  - MARSA LNG LLC will implement the community grievance mechanism to address stakeholder concerns related to the Project in a timely manner.

- Engage with SIPC regarding the development of a Marine Traffic Management Plan, including:
  - Process of notification to mariners of the presence of operations.
  - Standard vessel navigation and communication equipment such as radar, ship-to-ship radio, etc. will be utilised.
  - Monitoring of marine vessel traffic in the area with SIPC support
  - Consultation on an ongoing basis with fishermen and fishermen organisations (cooperatives) particularly regarding offshore activities and any safety requirements with respect to exclusion zones.
  - A fishermen representative will act as a liaison between the Project and the fishermen venturing the area in order to facilitate and improve the communication and cooperation between the parties.
  - All Project vessels will have Health, Safety and Environmental management systems in place in accordance with international regulations (MARPOL).
  - Coordination meetings between MARSA LNG LLC and SIPC will be carried out regularly in regard to marine traffic advises and enforcement of exclusion and restricted areas
  - Consultation on an ongoing basis with fishermen particularly regarding their safe passage along the coast and formal and informal fishing practices in the area
  - Patrolling for enforcement of exclusion zone will continue to be led by the ROP in collaboration with the SIPC and the port authorities.
  - The Project should ensure that the parties engaged in maintaining the exclusion zones/avoidance areas have received adequate training on appropriate code of conduct and

rules of engagement in accordance with the UN Voluntary Principles on Security and Human Rights.
- A selection of appropriate marine equipment and implementation of high levels of vessel maintenance, captain awareness and training.
- Hook-up to the GMA VTMIS (Vessel Traffic Management Information System) for access to real-time data on the presence of vessels in the vicinity of the exclusion zones.
- Marine contractors shall submit suitable HSE plans including a security management plan and marine safety risk assessment including qualifications of marine vessel captains and crew, training conducted, and compliance auditing provisions.
- The Project will establish a Grievance Mechanism to follow-up and close out any issues reported by stakeholders in regard to disturbance to fishing and right of passage
- A Marine Traffic Study will be developed as part of the Marine Traffic Plan to undertake a detailed assessment of navigation routes for local fishermen further away from the coast and offshore by assessing the potential for interaction with marine traffic in the area and information on quantity and frequency of fishermen boats, including:
  - Assessment of the navigation routes for local fishermen and the frequency of the use of the safety passage;
  - Identification of potential additional impacts from increased restrictions to passage due to the construction of the Project jetty;
  - Monitoring of marine vessel traffic in the area with the SIPC support
  - Identification of the main sea users, including artisanal fishermen and commercial fishing entities.

- A participatory community needs assessment will be developed, with a focus on AoI settlements and taking into account fishing communities, to inform the Project’s community investment strategy.

8.6.3.5 Residual impacts

As per the Increased Safety Risks due to Increased Marine Traffic and vessel collisions impact, considering the adoption of the embedded controls inherent in the Project design and the proposed measures to mitigate direct impacts, the risk is minimized. A Marine Traffic Plan will be developed so to avoid interactions between Project vessels and fishing or shipping vessels in the area. This should significantly reduce the scale and frequency of the impact. Thus, the residual impact is considered as of **MINOR** significance.

As per the Environmental health – air quality impact, mitigation measures proposed in addition to existing controls (i.e. filtering systems and metering stations) and careful equipment selection cannot completely prevent the emission of air pollutants. Ambient air quality and source emission monitoring should be conducted to ensure that ambient air quality is in line with local legislated limits. The residual impact is considered as of **MINOR** significance.

As per the increased transmission of communicable diseases impact, considering the adoption of the embedded controls inherent in the Project design and the proposed measures to mitigate direct impacts, the risk is minimized. The residual impact is considered as of **MINOR** significance.

As per the increased pressure on health care impact, considering the project embedded controls related to offering medical healthcare in camps and at construction site and the mitigation measures such a capacity needs assessment of the hospitals nearby, the risk should be minimized. The residual impact is considered as of **MINOR** significance.

8.6.4 Traffic and Transport (TT)

8.6.4.1 Impact Identification

This section presents the potential impacts to traffic and transport as a result of project related activity. In addition to the commitments made by MARSA LNG LLC, a series of mitigation measures have been designed to ensure that the level of impacts to socioeconomic receptors is avoided, minimised or reduced. In relation to other infrastructure aspects

Table 8-30 presents the key potential impacts of the Project on traffic and transport. Further detailed assessment is carried out in the next subsections.

Table 8-30 Key Potential Impacts –Traffic and Transport

Construction and Commissioning phase	Operation phase	Decommissioning phase
TT1- Disruption to existing road users on local roads during construction	TT2- Disruption to existing road users on local roads during operations	TT3-Disruption to existing road users on local roads during decommissioning

8.6.4.2 Key Considerations

Box 8-15 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-15 Key Considerations for Assessment – Traffic and Transport

Sources of Impact

- Construction: During the construction activities a peak motor transport traffic of 150 vehicles per day is foreseen, mainly related to the movement of workers (bus, van, pick-up) and heavy equipment. The mobilisation activities will consist of the heavy equipment transportation through main existing transportation routes, while raw materials will be sourced locally, wherever possible. Pipeline components, packages and main containers will be shipped to Sohar port and then transferred to the relevant locations by trucks.
- Operations: During the operation phase, the estimated traffic will include a limited number of vehicles per day, mainly cars and vans transporting the workers involved in the LNG site operation and a few trucks for transportation of goods and materials.

Particular Baseline Conditions that Potentially Influence Impacts

- Significant road improvements were noted at the local level since the establishment of the Port, which has reportedly led to increased road safety through the installation of speed radars and better road quality. There are also well-developed internal roads within and between settlements in the Sohar area.
- The number of accidents in Oman decreased 60% – from 3,845 in 2017 to 1,539 in 2021. In 2017, there was an accident every three hours which reduced to one every six hours at the end of 2021. In 2021, traffic accidents resulted in 1,621 injuries and 434 deaths. Omanis accounted for 76% of the total injuries and 66% of deaths. Data shows that 640 people were killed in traffic accidents in 2017, 637 in 2018, 511 in 2019 and 371 in 2020. Speed was the biggest cause of accidents, with 820 caused by speeding vehicles, constituting 53.3 per cent of the total traffic accidents. Other causes of accidents include misconduct while driving (282 accidents), negligence (153), failure to leave appropriate safe distance between vehicles (122), overtaking (56) and vehicle defects (41). Sixty-five traffic accidents occurred as a result of other reasons in 2021. [140]

Project Factors that Potentially Influence Impacts

- The Mashal-Al Nur Road 1 which is expected to be used for the delivery of goods and materials as well as for the workers access to construction runs parallel to Al Khuwayrah.

[140] Road accidents in Oman down 60% - Muscat Daily, accessed on 29 July 2023

- The LNG Plant Construction Activities are expected to last about 34 months including commissioning and pre-commissioning.
- Once commissioned, the operational activities and maintenance activities will start at the LNG Site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- The Sohar Port area and Freezone Port Area are already developed and include facilities and infrastructure that will be utilised by the LNG Bunkering Project. Some of these will be used directly, such as the existing accommodation camps and laydown areas or warehouses in the Freezone Port Area, the water supply network, waste and wastewater treatment facilities, existing roads etc. at the Sohar Port Area. Other roads will be slightly modified in order to reach the LNG plant, including access road to the site or small modifications to the port substation in order to accommodate the new transmission line.
- The roads used to access to the LNG plant for maintenance will be the same as those used during the construction activities.

The following subsections present the impact evaluation during Construction and Commissioning phase.

8.6.4.3 Impact Assessment

Construction and Commissioning phase

TT1 Disruption to existing road users on local roads

Traffic generated during construction of the LNG Plant will arise as a result of the following construction activities:

- Delivery of construction materials and equipment to the construction sites;
- Delivery of operational infrastructure; and
- Worker access to the site from the construction compound during construction and worker access (in private vehicles) in and out of construction camps.

Considering pipeline components, packages and main containers will be shipped to Sohar port and then transferred to the relevant locations by trucks inside the Port compound, the delivery of construction and operational materials and equipment is assumed not to have a direct impact in regard to disruption to existing road users, as roads outside the Port would not be used.

However, during operations phase, the estimated traffic will include a limited number of vehicles per day, mainly cars and vans transporting the workers involved in the LNG site operation and a few trucks for transportation of goods and materials. Considering that the number of workers will be largest during construction – upwards to 1,800- construction traffic has the potential to cause increased traffic, some disruption to and/or temporary blockages for existing road users. Impacts would be temporary, associated with the duration of construction (particularly during peak periods) and would be managed through the application of a Traffic Management Plan. During operations, few vehicles will be sourcing goods and materials and the number of workers to be transported will be significantly reduced to approximately 120.

For construction, the frequency and low number of project-related vehicles means that the magnitude of the impact is **small**. The sensitivity of the receptors is **medium** due to the fact that accidents resulting in injuries or fatalities remain a possibility albeit the low likelihood. Therefore, the impact significance is **minor**.

Potential impact descriptors for TT1 and TT3							
Construction							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

For operations, the numbers of project-related vehicles will be even less, thus the magnitude is **negligible.** The sensitivity of the receptors is **medium** due to the fact that accidents resulting in injuries or fatalities remain a possibility albeit the low likelihood. Therefore, the impact significance is **negligible**.

Potential impact descriptors for TT2							
Operations							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	NEGLIGIBLE	MEDIUM	**Negligible**

8.6.4.4 Mitigation measures

Good international industry practice and operational management should be able to greatly reduce the potential impact of the Project. The following mitigation or preventive measures will be implemented:

A Traffic Management Plan will be developed in consultation with the competent authorities, traffic police and municipalities, and implemented throughout construction. The following measures will be adopted in the Project *Traffic Management Plan* to mitigate the impacts of construction traffic:

- The Contractor will liaise with the appropriate regulatory authorities to gain approval to use, and regularly inspect, the road infrastructure;
- Precautions will be taken by the Contractor to avoid damage to the public roads used by vehicles or other items of equipment. Where tracked equipment will be used, timber mats, tyres or steel plates will be laid as necessary. Any road damage will be repaired to an equal or better standard in a timely manner;
- Advance warning will be given of any proposed road diversions and closures (if required);
- If road closures are required, diversions will be planned and communicated to the authorities (including emergency services and public transport providers) and affected communities in advance (via the pre-construction community meeting) and will be properly sign-posted.
- Crossing for pedestrians and animals will be provided to avoid the need for a diversion.
- If the Contractor requires additional routes, a specific proposal will be submitted to the relevant authorities for consideration and approval;
- Liaison with the police and other authorities will occur prior to the movement of any abnormal loads.
- Speed limits will be established and enforced over all construction traffic routes;
- The Contractor will comply with all statutory vehicle limits (width, height, loading, gross weight) and any other statutory requirement;

- Drivers of Project vehicles will be trained/briefed about safe driving with respect to other drivers, pedestrians, cyclists and livestock);
- Clear signs, flagmen and signals will be set up where necessary. Where temporary traffic signals are required, the details and locations of the signs shall be discussed with the relevant authorities. The signs will be fixed safely and securely to ensure that they do not become detached or dislocated and will be visible and comprehensible by all. The Contractor will also carry out maintenance checks to clean and re-secure signs if necessary;
- Signing will be provided (where it is not already present) to advise drivers of distances to the next passing location (to minimise inappropriate overtaking of slow-moving vehicles);
- Project vehicles to be identifiable to the Project (e.g. an easy to read/see sign or symbol on vehicles which shows that they are connected to the Project);
- All Project vehicles will be regularly maintained, and drivers will be trained in driving methods designed to avoid unnecessary emissions and which are considerate to the local communities (e.g. switching engines off when waiting to enter site or stationary on site, avoiding engine stress and reducing vehicle speed in and near communities);
- Assignment of heavy vehicle construction traffic to suitable routes to and from the working area;
- Temporary road closures (during works for new or altered roads) will be scheduled, as far as is practical, during times which will minimise disruption to road users (and planned in conjunction with the authority);
- Advanced warning of the proposed temporary road closures and diversions will be provided to the public (e.g. suitable signage and information in the press);
- Address how the Contractor can reduce the exposure of vehicle drivers, their passengers and other road users from the hazards of road-related accidents;
- Education on traffic safety will be provided by the Community Liaison Officers (CLOs) to communities not normally subjected to high traffic loads;
- Provide briefings and awareness raising for workers on work camps with respect to safe and considerate driving;
- The Contractor shall be expected to develop and implement management systems and procedures that will provide the highest level of control over hazards to personnel associated with vehicle transportation, both on- and off-road;
- The Contractor's procedures shall specifically cover arrangements for the following important aspects:
  - The source of and number of qualified drivers required.
  - Training and approval requirements for drivers.
  - Hours of driving and rest periods.
  - Security arrangements for drivers, vehicles and loads.
  - Arrangements for driver communication with control points and vehicle equipment.
  - Language/communication issues.
  - The source of suitable vehicles (e.g. quality and specification).
  - The number of vehicles required.
  - The programme for preventative vehicle maintenance.
  - Vehicle routes, route planning and alternative routes.
  - Overall vehicle movements.
  - Procedures for the emergency recovery of vehicles.
  - An appraisal of the socioeconomic impacts of vehicles in the local community.
  - Procedures for spot checks and audits of the transport system and for reporting problems.
- Control and supervision of the arrival and departure of construction traffic at site entrance;

- Agreement of routes to be used by vehicles delivering ‘abnormal loads’ (i.e. slow moving, very high or wide loads) and their timing in conjunction with the authority (and the Police); provision of advance warning of the routes and times of abnormal load deliveries;
- Restrictions on construction traffic movements during periods of heavy traffic on the road network if necessary;
- The contractor will be required to undertake regular inspections to ensure adherence to the Traffic Management Plan;
- Provision shall be given for the continuation of normal traffic during open-cut road crossings and all open cuts shall be covered at the end of each working day
- If night-time work is required under an emergency operation, then warning lights will be used around the working site;
- A method statement will be produced for each crossing, for approval by the appropriate authorities prior to commencing work;
- Where roads used by children to reach schools are utilised by construction traffic, road safety education will be provided at schools. Vehicle traffic will be minimised during hours that children are travelling to and from school;
- Appropriate supervision will be provided by the Contractor to control the flow of traffic when machinery needs to cross roads;
- Traffic flows will be timed, wherever practicable, to avoid periods of heavy traffic flow along main roads.
- Access and site roads will be maintained in good condition.
- Dedicated areas will be designated for end of day parking and routine maintenance / checks of the project vehicles. These areas will be away from public and private lands to avoid nuisance to public and complaints.

8.6.4.5 Residual impacts

Impacts would be short term, particularly during the peak construction periods and would be managed through the implementation of a Traffic Management Plan. While the Project has developed and implemented a Road Safety Management Procedure, as summarized above, to further reduce the likelihood (and consequence) of a vehicular accident, the residual risk rating is maintained at **MINOR.** Disruption to existing road users on local roads during operations will continue to have a **NEGLIGIBLE** residual risk rating.

8.6.5 Community Cohesion and Expectations (CC)

8.6.5.1 Impact Identification

This section outlines the potential impacts to community cohesion from project related activities. The term *community cohesion* refers to the quality and quantity of interactions between members of a community (intra-community) and between different communities (inter-community). It describes the capacity to function and develop together, based on integration and the ability to manage conflicts within the community/between neighbouring communities. Community cohesion has to be considered as a continuous process interweaving a broad background fabric of issues such as access to education and employment, poverty and socioeconomic inequalities, socioeconomic and cultural diversity, access to communication and information. A high level of community cohesion would implicate respect for persons as individuals, sensitiveness to ethnic and socioeconomic differences and a sense of belonging to the community/to a local set of communities.

A change in the overall socioeconomic setting of an area by any new project could potentially influence relationships among community members and between different communities, resulting in, for example, heightened tensions which would affect the complex fabric of community cohesion on the intra-community and inter-community level. However, due to the development of the port since 2003 the port area has accommodated a number of developments operated by international clients. Hence, the effect of the Project activities on community cohesion is not expected to be significant.

In addition to the commitments made by MARSA LNG LLC, a series of mitigation measures have been designed to ensure that the level of impacts to socioeconomic receptors is avoided, minimised or reduced.

Table 8-31 presents the key potential impacts of the Project on community cohesion. Further detailed assessment is carried out in the next subsections.

Table 8-31 Key Potential Impacts –Community Cohesion

Construction and Commissioning phase	Operation phase	Decommissioning phase
CC1 – Disturbance from presence of workforce CC2 - Influx of Non-Local Workers and Opportunity Seekers CC3- Unmet expectations of benefits	CC4 – Unmet expectations of benefits	CC5 – Unmet expectations of benefits

8.6.5.2 Key Considerations

Box 8-16 presents the key sources of impacts, baseline, and project factors influencing the impact.

Box 8-16 Key Considerations for Assessment – Community Cohesion

Sources of Impact

- Up to 1,800 Omani and foreign workers may be brought into the area during construction phase.

Particular Baseline Conditions that Potentially Influence Impacts

- The LNG Plant Construction Activities are expected to last about 34 months including commissioning and pre-commissioning.
- Once commissioned, the operational activities and maintenance activities will start at the LNG Site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- Waged employment in the study area is low and youth unemployment rates are very high despite developments in the port area. Local youth from the area may face competition with Omani nationals from other areas.
- The common concern raised from all communities was regarding odours which they link to perceived poor air quality caused by port emissions. Concerns regarding the impacts of Air Quality on health were also raised.
- The main complaint from fishermen was regarding decreased access to fishing grounds caused by the port in the past. This has led to an increasing competition among fishermen for limited resources.
- High literacy rates (95%) but low rates of employment in mid-high-level positions. While local community and governmental stakeholders claim that education levels and multiple specialisations for highly qualified positions (i.e. engineers, managers, etc.) are available at the local level, there seems to be a discrepancy between the skills and qualifications that industrial companies in the Port are looking for and the skills available in the local market.

- Community composition of the villages has a strong historical influence, as families tend to remain in the village in which they were born, which has led to some villages being dominated by families with more political preeminence. During the project engagement process, it was reported that some tension may exist between sheikhs of different settlements and even within a same settlement, especially with respect to matters of social investment.

Project Factors that Potentially Influence Impacts

- High expectation of employment creates tension.
- Type and management of worker housing including level of interaction, Project facilities (e.g. recreational activities), and whether housing is a mixed or isolated development.
- Manner in which the Project interacts with communities, particularly transparency of information provision by the Project and inclusivity of engagement.
- Management of impacts including management of the social and environmental investment program.

Relevant existing Controls/Mitigations

- MARSA LNG LLC will have an open and transparent policy on employment to ensure equitable access to job opportunities.
- MARSA LNG LLC will implement a program of social investment targeting communities in the AoI.

The following subsections present the impact evaluation during the three project phases (Construction and Commissioning phase; operation phase and; decommissioning phase)

8.6.5.3 Impact Assessment

CC1- Disturbance from presence of workforce

The potential exists for tensions to arise between communities and the workforce (due to cultural differences). In addition, there may be tensions between different groups within the workforce. The tensions between locals and expatriates may refer to the typical rivalry for job offers that has been very nuanced by the Omanisation policy. However, no additional tensions are expected to exist between locals and expatriates, as the expatriate population represents a large number throughout Oman and the local population is adapted to this social landscape. The concentration of a predominantly male workforce, living in labour camps can increase the incidence of issues such as:

- Providing offence to cultural norms;
- Marginal activities such as gambling or substance abuse which may conflict with local sensitivities; and
- Petty crime and fighting

The likelihood of negative interactions between the community and the workforce such as the above will be considerably reduced, as major part of the workers will be accommodated in camps where all the necessary services are provided. While in the field, breaks will take place during pauses in work in the field. Each local worker’s off time will be spent at their home location.

Considering the project embedded measures, the magnitude of the impact is considered to be **small** and the receptors’ sensitivity **medium**. Therefore, the impact significance is **MINOR**.

Potential impact descriptors for CC1							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

CC2- Influx of Non-Local Workers and Opportunity Seekers

Non-local workers, both Omani and third-party nationals will be brought into the vicinity of Project activities through a managed process of recruitment and transportation. It is estimated that 1,800 will constitute the personnel involved in the construction in peak times during the 34-months construction period. Of this figure, at least 30% will be Omanis and the remaining 70% will be expatriates. During operations this number will fall to 120. Workers will mostly be housed in self-contained camps and will be subject to a code of conduct with regard to their behaviour and conduct towards local people.

In addition to the directly hired project labour, it is also possible that people could move towards project locations in the hope of finding work directly with the Project or to gain benefit from the indirect economic opportunities that the Project may bring, such as selling goods or services to the Project or its workforce. While not common in the Omani context, the possibility still exists with Omanis moving into the area in seek of opportunities not prevalent in their regions.

Such influx of opportunity seekers would be unmanaged and, should it be significant, is likely to pressurise the limited services and infrastructure in the local settlements. A high degree of influx could result in other effects such as inflation, socioeconomic tensions, and changes to behavioural norms. However, such a scale of influx is considered unlikely for the Project, due to the application of proactive recruitment and local content measures (with priority for local workers; offsite recruitment; etc.). Thus, the impact is considered as of **small** magnitude while the sensitivity of the receptors is considered **medium**. The impact significance is therefore **MINOR**.

Potential impact descriptors for CC2							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	SMALL	MEDIUM	**Minor**

CC3,4,5- Unmet Expectations and Benefits

In Sohar, air quality degradation and perceived health effects in the Port area were cited as contributing factors in the build-up leading to protests in the past, along with distrust towards authorities and the Port regarding air emissions and health issues, and the lack of transparency and communication channels on issues of concern.

Both community investment and continued stakeholder engagement were highlighted as priorities for community and government stakeholders alike and are perceived as key conditions to obtain and maintain the Project’s social license to operate. Expectations with respect to community investment are based on the community’s perception of social investment programs of Port tenants such as Orpic, Vale and Sohar Aluminium in collaboration with the private sector and CSR initiatives such as Jusoor, which follow the same standards as Oman LNG in Sur (ie.1.5% of revenues yearly). Although ONLG is much larger in size compared to MARSA LNG LLC’s Project, the standards set by the Port tenants have established a precedent in the area. Expectations with respect to community investment and stakeholder engagement are therefore high.

Expectations among local residents for employment opportunities are also expected to be high considering the unemployment rates at a local and regional level (for further details see ESIA baseline section). Moreover, it was reported that locals are not always prioritised during recruitment, with positions being filled by Omani nationals from other areas although the required skills may be available at the local level. This could lead to tension and competition between locals over available job opportunities and the potential for unmet expectations considering the limitations in scale and duration of employment opportunities.

It is unclear whether conflicts between and within settlements will emerge as the Project progresses and community investment is implemented. Resentment between beneficiary communities and non-beneficiaries especially could arise with respect to employment opportunities and support (Social investment programs, training opportunities, etc.).

Similarly, stakeholder engagement meetings with fishermen revealed dissatisfaction in regard to the compensation provided when the Sohar Port was constructed. This feeling pervades local fishermen, who still claim to have traditional legacy rights in relation to fishing areas. The strict enforcement of restrictive measures tilting a situation of tolerance to a situation of restriction towards tolerated fishing practices in the SIPC concession area could lead to a negative perception of the project.

The potential impact to sensitive receptors is **medium** magnitude. The receptor sensitivity is deemed to be **medium** as local communities and fishermen unmet expectation could result in a reduction in local acceptance of the Project as it moves into the construction phase, which if unmanaged, could present a risk of Project delays. Thus, the impact significance is **MODERATE**.

Potential impact descriptors for CC3,4,5							
Type	**Scale**	**Duration**	**Frequency**	**Extent**	**Magnitude**	**Sensitivity**	**Significance**
Direct		Temporary	Occasional	Local	MEDIUM	MEDIUM	**Moderate**

8.6.5.4 Mitigation measures

Good practice and operation management should be able to greatly reduce the potential impact of the Project. The following mitigation or preventive measures will be implemented:

- Stakeholder Engagement Plan (SEP). Through different communication and engagement methods, stakeholders in the immediate vicinity of the construction works will be kept informed about the planned activities, timelines, potential impacts and changes to schedules, if any. Stakeholders should be made aware of whom to address and how to raise any concerns or grievances. This will include the following:
  - Communication will be based on the principle of transparency and clarity, clearly explaining the selection process and criteria. This will imply transparent and clear communication in regard to the rules of equitable distribution amongst AoI communities and the establishment of priorities for Social investment.
  - Quarterly project update leaflets will be prepared and widely distributed from six month prior to construction to the end of the construction phase. These information releases will emphasise the limited nature of employment and the recruitment processes and the inclusive nature and progress of the Social Investment Plan.
  - The grievance mechanism will be adjusted to the Project construction phase with the relevant contractor and sub-contractor staff fully aware of their roles in third party grievance resolution process so that quick and effective response is provided to the concerns raised by local stakeholders; additional resources if necessary to resolve concerns within stipulated timescales.
  - The Project will communicate to affected stakeholders the progress on meeting the Project's environmental and socioeconomic commitments during the construction phase through, at a minimum the release of quarterly performance reports which will be posted on the Project website.
  - The Project will agree with government and other stakeholders the scope of third-party monitoring, which might involve local stakeholder representatives, in assessing whether social and environmental impact mitigation measures and other intended benefits are as

effective as anticipated. The reports of the third-party monitoring will be made available to the public through MARSA LNG LLC website.
- Meeting minimum standards for stakeholder engagement and social performance will be used as one of the selection criteria for the main contractors.
- Communities will be engaged in the preparation of the social and environmental investment activities to be taken forward in the vicinity of their communities. They will then be kept informed on the progress of such activities and opportunities for their involvement will be maximised.
- Fair distribution of potential project-related opportunities among AoI communities to minimize tension and competition between locals.
- Ongoing dialogue between the Project, through the Community Liaison Officer (CLO) and local communities to assist in information sharing with regard to employment practices and the use of non-local staff. Local communities to be provided information on the number of non-locals to be brought to the area, their housing arrangements and the measures that the Project is putting in place to ensure that all workers abide by local customary practices. Information will also be shared on the number of local unskilled and semi-skilled as well as skilled positions available to local residents, along with the recruitment methods used to identify potential candidates.
- Relevant Project information in particular those related to environmental and socioeconomic impacts, employment and project benefits will be disclosed at the local level in a manner that is accessible, understandable and culturally appropriate for those affected. This will be facilitated by the MARSA LNG LLC and EPC Contractor Community Liaison Officers (CLOs) employed for the duration of construction and operation activities. The CLOs will proactively and regularly engage with local stakeholders prior to commencement of construction activities, providing updates and answering their queries. The CLOs will be present on the ground during the whole construction process and available to the potentially affected communities. The aim of this is to ensure that all working practices are transparent and any issues between local residents and non-local workers are communicated and dealt with early on.

- The following stakeholder engagement measures will be implemented during operations:
  - Reduction and / or replacement of community liaison officers will be carefully managed during the transitioning of construction to operation in order to maintain the knowledge and relationships built between project representatives and local stakeholders until this point and ensure continuity. Retaining the same community liaison personnel or ensuring overlap between outgoing and incoming teams for successful knowledge transfer will be considered during this period. Stakeholders will be kept informed about changes that will impact them due to transfer to the operation phase. Commitments made to stakeholders relevant to the operation phase will be integrated into operation phase management systems and functions;
  - The Project will continue to engage with stakeholders through a combination of meetings, focus groups, surveys, suggestion boxes, etc. The plan for stakeholder engagement for the operation phase will be finalised six months prior to the transition to operations and shared with key stakeholders. The plan will also be posted on the Project website.
  - Stakeholder information will be reviewed on at least on annual basis to reflect changes in leadership, the emergence of new groups or shift in concerns or influences of existing ones;
  - The communications mechanisms and success of these will be reviewed annually for effectiveness and the stakeholder engagement plan will be revised to take into account the results of the review.
  - A publicly disclosed annual report will be prepared that will include meeting ESIA and other commitments, changes made to project design or operational procedures with potential impacts on certain stakeholder groups, any unforeseen changes, regular maintenance procedures, emergency response plans and safety and security requirements, and social and environmental investment activities and outcomes. The coverage of different issues will be proportionate to the extent of Project impacts and stakeholder interests.

  - The grievance mechanism will remain in place and regularly communicated to stakeholders.
  - The Project will involve affected stakeholders or third-party representatives in monitoring of the Project's socioeconomic and environmental performance for issues of great interest to the public.
- Local Economy and Employment mitigation measures (Section 8.6.1) for the Influx of Non-Local Workers and Opportunity Seekers mitigation measures (employment strategy, information release) are also applicable.
- For workers housed in private residences, a monitoring plan regarding worker-family interactions will be established. The monitoring plan will be described in the Worker Management Plan.
- The EPC Contractor will be required to develop a Workers Management Plan, which will set out the conditions of employment and expected behavioural practices of all employees during the construction phase (no offence to cultural norms; no marginal activities such as gambling or substance abuse; no petty crime and fighting, no sexual abuse).
- Grievance Mechanism. A Project grievance mechanism, as described in the Project SEP, will be implemented, and information about this mechanism will be shared amongst local communities. The EPC Contractor will also be responsible for managing a grievance mechanism that allows communities and employees to raise complaints. This will be a key monitoring and reporting requirement of the Project. The grievance mechanism will be implemented prior to commencement of the construction phase, with all relevant staff fully cognizant of their roles in the grievance resolution process so that quick and effective response is provided to the concerns raised by local stakeholders.
- A Social Investment Plan and Community Needs Assessment will be developed by the Project in consultation with local communities, with active engagement required to determine the location and nature of investments. Relevant stakeholders will be kept informed on the progress of investment activities and opportunities.

8.6.5.5 Residual impacts

As per the disturbance from presence of workers impact, the scale and likelihood of the tensions arising will be significantly reduced as a result of the proposed mitigation such that it will become a non-routine event. The residual impact is considered of **NEGLIGIBLE** significance.

As per the Influx of Non-Local Workers and Opportunity Seekers impact, considering the adoption of the embedded controls inherent in the Project design and the proposed measures to mitigate direct impacts, the risk is minimized. Influx will be mainly managed with most of the employees housed in accommodation camps. Unmanaged influx is likely to be insignificant. Thus, the residual impact is considered of **NEGLIGIBLE** significance.

As per the Unmet Expectations and Benefits impact, best efforts will be put in managing expectations. The social investment program should commence as soon as the construction phase begins so as the delivery of tangible benefits is considered by all stakeholders. If this is followed, the residual impact is considered of **MINOR** significance.

8.7 Ecosystem Services (ES)

Ecosystem services are the benefits that ecosystems provide to people, including many resources that underpin basic human health and survival needs, support economic activities and provide cultural fulfilment. The ecosystem services categories are described in Box 8-17.

Box 8-17 Ecosystem services

Ecosystem services are benefits that ecosystems provide to people. The Millennium Ecosystem Assessment [141] classified them into four main categories to provide a clear and consistent classification scheme:

- **Provisioning services** are the goods or products obtained from ecosystems, such as food, timber, medicines, fibers and freshwater.
- **Regulating services** are the benefits obtained from an ecosystem's control of natural processes, such as climate regulation, disease control, erosion prevention, water flow regulation, and protection from natural hazards.
- **Cultural services** are the nonmaterial benefits obtained from ecosystems, such as recreation, sacred sites and aesthetic enjoyment.
- **Supporting services** are the natural processes, such as soil formation, nutrient cycling and primary production, that maintain the other services.

The Ecosystem Services impacts identification has been performed applying the IPIECA Ecosystem Services Guidance (IPIECA, 2011). This guidance approach provides a set of checklists to help identify the main habitats involved in the Project area and associated ecosystem services, ecosystem service dependencies and impacts of Oil and Gas developments.

8.7.1 Ecosystem Services Screening

The objective of ecosystem services screening is to develop a comprehensive list of the ecosystem services likely to be present in the Project area. This step does not attempt to consider the importance of the services to beneficiaries or the likelihood of the Project impacting these services; it aims to demonstrate whether a service is likely to be present or not.

For a service to be considered present, it must meet two criteria:

- The habitats present in the Project area are known to provide this service or are similar to habitats elsewhere that provide this service; and
- People are believed to benefit from the service, either at the local, national or global level and /or the Project is expected to benefit from this service.

According to the baseline data and the aforementioned guidance document, the following habitat types are the ones present in the Project area, thus the ones that could be potentially affected by the Project activities: desert habitat and nearshore/transition zone habitat.

- Desert: The Project area is located in the Gulf of Oman desert and semi-desert terrestrial ecoregion. Desert and semi-arid habitats are typified by low average rainfall, high evaporation rates, and high mean temperatures. Provisioning services in desert and dryland habitats include food, freshwater and grazing habitat for livestock. Desert plants supply a regulating service in the form of erosion control.
- Near shore/transition zone: The LNG Plant is located at the Sohar Port, on the northeast coast of Oman on the Al Batinah coast. The plant will be built on reclaimed land, and ships will reach the loading jetty to be operated by MARSA LNG LLC via an approach channel. In near shore waters, artisanal and subsistence fishing are critical provisioning services. Key regulating services from habitats such as can include protection from storms, flooding and erosion. Some of them can also offer water filtration, waste assimilation and carbon sequestration services. The near shore

(141) Millennium Ecosystem Assessment https://www.millenniumassessment.org/en/index.html

environment offers cultural services in the form of tourism and recreation (e.g., swimming, diving, sunbathing), and supports a variety of iconic species including reef-associated fish, turtles, sharks, dugong and coastal seabirds.

Table 8-32 presents the high importance ecosystem services present per habitat in which they are found.

Table 8-32 Existing of High Importance Ecosystems Services per Habitat type

Ecosystem Services	Deserts	Near shore/ Transition Zone
Provisioning Services		
Crops		
Livestock		
Food provisioning (Capture fisheries)		X
Aquaculture		X
Wild foods		X
Timber and other wood fibers	X	
Fibers and resins		
Animal skins		
Sand, gravel, etc.	X	
Ornamental resources		X
Biomass fuel		X
Freshwater		
Genetic resources	X	X
Biochemicals, natural medicines, and pharmaceuticals		X
Regulating Services		
Air quality regulation		
Global climate regulation		X
Regional/local climate regulation	X	
Water regulation		X
Erosion regulation		X
Water purification		X
Waste assimilation		X
Disease regulation		
Soil quality regulation		
Rest/invasive species regulation		
Pollination		
Natural hazard regulation		X
Cultural Services		
Recreation and ecotourism	X	X
Spiritual and religious values	X	X
Ethical/non-use values	X	X

Source: Adapted from the Ecosystem services guidance, IPIECA, 2011.

8.7.2 Impact identification and assessment

The identification and assessment of the potential impacts on ecosystem services during the different phases of the Project, considering both its onshore and offshore activities. The following elements are considered in the impact identification and assessment:

- **Sources of Impact**: potential sources of impact of the Project based on the Project activities and environmental and social baseline information obtained for the Project area.
- **Project Dependence:** IFC PS-6 requires that the Ecosystem services assessment take into consideration any services that the Project may rely upon during construction, operation and/or decommissioning.
- **Potential Beneficiaries**: Known and potential beneficiaries for a service.

As a given ecosystem provides multiple services of different categories (provisioning, regulating, cultural, supporting services), the impacts are organised per each ecosystem identified in the area, analyzing how the different activities proposed by the Project may affect each of the categories of the ecosystem services they are providing. The identification and assessment of the impacts on ecosystem services has been based on the ecosystem service checklists per project phase and habitat type (desert and nearshore) of the IPIECA Ecosystem Services Guidance (IPIECA, 2011).

The mitigation measures proposed in the previous sections of the impact assessment for the environmental and socioeconomic components will also apply for the ecosystem services assessed in the tables below.

Table 8-33 Identification of impacts and risks to ecosystem services during the construction and commissioning phase

Sub-activity Issue	Potential impact	Dependencies on Ecosystem Services				Impacts on Ecosystem Service			
		Provisioning	Regulating	Cultural	Supporting	Provisioning	Regulating	Cultural	Supporting
Marine vessels: Operation and general presence	ME&H1 – Degradation of marine habitat quality and ecosystem function from Project construction activities. PS/CH1– Impacts to Protected Species and Critical Habitat arising from increased emissions of underwater noise and increased risk of ship strikes SQ1 – Degradation of marine environment quality from material transport by sea, construction and commissioning activities and materials	N/A	Assimilation services (e.g. dilution and microbial action) to help break down and disperse oil and chemicals.	N/A	N/A	Possible reduction in fisheries and fish for consumption. Possible impacts on fisheries due to disturbance and alien-invasive species.	N/A	N/A	N/A
Chemical handling and use – permitted releases	SQ1 – Degradation of marine environment quality from material transport by sea, construction and commissioning activities and materials	N/A	Assimilation services (e.g. dilution and microbial action) to help break down and disperse oil and chemicals.	N/A	N/A	Possible reduction in fisheries (especially perceived impacts)	N/A	Possible negative impacts for marine tourism and recreation (e.g. swimming and bathing).	N/A
Landscape alteration: from the construction of the facility and construction works	LF1 – Reduced landscape aesthetic from material laydown area and dust generation during construction.	N/A	N/A	N/A	N/A	N/A	N/A	Visual and aesthetic impact on enjoyment of locals.	N/A
Construction works: Excavation, building, etc.	THE1- Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material during construction AQ1 - Reduced ambient air quality caused by vehicles and machinery, flaring, furnace heating start up activities Contribution to climate change N1 – Noise emissions from construction equipment, machineries and vehicles, potentially affecting the acoustic	Use of aggregates (sand, gravel, rocks, etc.). Use of local natural materials (e.g. aggregates) for foundations, concrete, etc. Use of water.	Natural flood, erosion and storm controls at site.	N/A	N/A	Disturbance of fauna	Interference with natural water supplies downstream (surface and groundwater).	Disturbance of tranquillity of area for local communities, visitors and iconic species	N/A

Sub-activity Issue	Potential impact	Dependencies on Ecosystem Services				Impacts on Ecosystem Service			
		Provisioning	Regulating	Cultural	Supporting	Provisioning	Regulating	Cultural	Supporting
	climate and generating nuisance to near population. S1 – Soil degradation and contamination during construction works GW1 – Groundwater degradation and diversion from excavation and spillage of hazardous material during construction. SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction. CHSS2 **-** Impacts on Environmental Health - Air Quality degradation TT1- Disruption to existing road users on local roads during construction								
Soil disposal: from site clearance, excavation and trenching	GW1 – Groundwater degradation and diversion from excavation and spillage of hazardous material during construction. SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction. S1 – Soil degradation and contamination during construction works.	N/A	Assimilation services of receiving soil and vegetation	N/A	N/A	Provision of a supply of soil, peat or rocks, etc. for other uses.	N/A	N/A	N/A
Provisioning workforce: providing food and water, etc.	Pressure on demand pf water and local food resources.	Use of water resources (desalinated sea water), food resources, etc.	N/A	Use of local recreation activities for workers (e.g. walking, birdwildlife watching, etc.)	N/A	New local market but increased pressure on use of water, etc.	N/A	N/A	N/A
Accidental events: Risk of spills, fires and explosions.	Risk of Uncontrolled loss of containment at the plant and of Vessel Collision	Use of water to control fires. Use of natural materials to absorb and prevent the spread of spill.	Assimilation services (e.g. dilution and microbial action) to help break down and disperse contamination	N/A	N/A	Reduction in provisioning foods and water through contamination by accidental event (actual and perceived).	Reduction of regulating services from loss of habitat extent and quality.	Reduction in local livelihoods, recreation and species through contamination (actual and perceived).	N/A

Table 8-34 Identification of impacts and risks to ecosystem services during the operation phase

Sub-activity Issue	Potential impact	Dependencies on Ecosystem Services				Impacts on Ecosystem Service			
		Provisioning	Regulating	Cultural	Supporting	Provisioning	Regulating	Cultural	Supporting
Marine vessels: Operation and general presence	PS/CH2 – Impacts to protected species and critical habitat from underwater noise and ship strikes ME&H2 – Degradation of marine habitat quality and ecosystem function from operation activities. SQ2 – Degradation of seawater and sediment quality as a result of vessel and jetty operations, and storm water runoff	N/A	N/A	N/A	N/A	Possible impacts on fisheries due to disturbance and alien-invasive species.	N/A	Disturbance (visual, auditory and physical) of iconic species (e.g. whales and turtles). Possible impacts on marine tourism and recreation (visual presence).	N/A
Chemical handling and use – permitted releases	SQ2 – Degradation of seawater and sediment quality as a result of vessel and jetty operations, and storm water runoff	N/A	Assimilation services (e.g. dilution and microbial action) to help break down and disperse oil and chemicals.	N/A	N/A	Possible reduction in fisheries (especially perceived impacts)	N/A	Possible negative impacts for marine tourism and recreation (e.g. swimming and bathing).	N/A
Facility footprint: Operation of facility (including flaring)	THE2 - Disruption to terrestrial ecology and habitat from the generation of noise, waste, and flaring. AQ2 - Reduced ambient air quality caused by flaring, incineration, furnace heating, and back-up electricity generators. Contribution to climate change. N2 – Noise nuisance from installed equipment in the LNG train, compressors, and pumps. S2 – Soil contamination from operational machinery and equipment	N/A	N/A	N/A	N/A	Disturbance of fauna	N/A	Visual impacts to communities, tourism and recreation.	N/A
Provisioning workforce: providing food and water, etc.	Pressure on demand of water and local food resources.	Use of water resources (desalinated sea water), food resources, etc.	N/A	Use of local recreation activities for workers (e.g. walking, bird/ wildlife watching, etc.)	N/A	New local market but increased pressure on use of water, etc.	N/A	N/A	N/A
General operation: Resource requirements in operation (water, electricity, etc.)	EE3 - Temporary direct and indirect employment opportunities (primarily unskilled)	Use of water resources (desalinated sea water), etc.	N/A	N/A	N/A	Increased pressure on use of water, etc.	N/A	N/A	N/A

Sub-activity Issue	Potential impact	Dependencies on Ecosystem Services				Impacts on Ecosystem Service			
		Provisioning	Regulating	Cultural	Supporting	Provisioning	Regulating	Cultural	Supporting
	EE4 - Temporary economic impacts from taxes and fees, procurement and worker spending Pressure on demand of water supply, fuel supply, electricity supply.								
Wastewater management and disposal of waste materials: General, hazardous	GW2 – Degradation of groundwater quality from handling of hazardous materials. SW2 – Contamination of storm water runoff from waste generation and handling of hazardous chemical substances S2 – Soil contamination from operational machinery and equipment	N/A	Assimilation services of receiving soil and vegetation.	N/A	N/A	Potential pollution of water supplies and impacts to fisheries (if it reaches main water bodies). Potentially useful products in the waste materials.	N/A	N/A	Visual and aesthetic impact to locals and visitors. Impacts on iconic species.
Visual presence: from permanent presence of the facility.	LF2– Reduced landscape aesthetic during operation.	N/A	N/A	N/A	N/A	N/A	N/A	Visual and aesthetic impact on enjoyment of locals.	N/A
Accidental events: Risk of spills, fires and explosions.	Risk of Uncontrolled loss of containment at the plant and of Vessel Collision	Use of water to control fires. Use of natural materials to absorb and prevent the spread of spill.	Assimilation services (e.g. dilution and microbial action) to help break down and disperse contamination	N/A	N/A	Reduction in provisioning foods and water through contamination by accidental event (actual and perceived).	Reduction of regulating services from loss of habitat extent and quality.	Reduction in local livelihoods, recreation and species through contamination (actual and perceived).	N/A

Table 8-35 Identification of impacts and risks to ecosystem services during the decommissioning phase

Sub-activity Issue	Potential impact	Dependencies on Ecosystem Services				Impacts on Ecosystem Service			
		Provisioning	Regulating	Cultural	Supporting	Provisioning	Regulating	Cultural	Supporting
Removal of above ground components and gravel	AQ3- Reduced ambient air quality caused by vehicles and machinery. N3 – Noise nuisance from heavy machinery. THE3 - Disruption to terrestrial ecology and habitat from waste generation and handling of hazardous material. TT3-Disruption to existing road users on local roads during decommissioning	N/A	N/A	N/A	N/A	N/A	N/A	Disturbance of tranquillity of area for local communities, visitors and iconic species	N/A
Disposal of waste materials: General, hazardous	S3 – Soil degradation and contamination from	Supporting Services - Soil formation	N/A	N/A	N/A	The volume of hazardous and non-hazardous material on site is likely to be greater in this phase and could lead to a major risk of soil contamination.	N/A	N/A	N/A
Wastewater management and disposal of waste materials: General, hazardous	GW3 – Degradation of groundwater quality and diversion from pipeline excavation works and hazardous materials. SW3 – Disruption and contamination of storm water runoff from pipeline excavations and handling of hazardous materials S3 – Soil degradation and contamination	N/A	Assimilation services of receiving soil and vegetation.	N/A	N/A	Potential pollution of water supplies and impacts to fisheries (if it reaches main water bodies). Potentially useful products in the waste materials.	N/A	N/A	Visual and aesthetic impact to locals and visitors. Impacts on iconic species.
Visual presence: from decommissioning activities	LF3 – Reduced landscape aesthetic from material laydown area and dust generation during decommissioning.	N/A	N/A	N/A	N/A	N/A	N/A	Visual and aesthetic impact on enjoyment of locals.	N/A
Provisioning workforce: providing food and water, etc.	Pressure on demand of water and local food resources.	Use of water resources (desalinated sea water), food resources, etc.	N/A	Use of local recreation activities for workers (e.g. walking, bird/wildlife watching, etc.)	N/A	New local market but increased pressure on use of water, etc.	N/A	N/A	N/A
Accidental events: Risk of spills, fires and explosions.	Risk of Uncontrolled loss of containment at the plant and of Vessel Collision	Use of water to control fires. Use of natural materials to absorb and prevent the spread of spill.	Assimilation services (e.g., dilution and microbial action) to help break down and disperse contamination	N/A	N/A	Reduction in provisioning foods and water through contamination by accidental event (actual and perceived).	Reduction of regulating services from loss of habitat extent and quality.	Reduction in local livelihoods, recreation and species through contamination (actual and perceived).	N/A

8.8 Climate Affairs

The MD 20/2016 and MECA (now EA) Guideline: Form 1 (2017) requires that a project's aspects and impacts related to climate change be assessed as part of an EIA, as previously mentioned in Section 8.2.10.

In addition, according to Equatorial Principles (EP4), for projects categorized as Category A as defined in Section 8.2.11, a Climate Change Risk Assessment (CCRA) should include consideration of relevant climate-related 'Physical Risks' as defined by the Task Force on Climate-Related Financial Disclosure (TCFD). In addition, if, when combined Scope 1 and Scope 2 emissions exceed 100,000 tonnes of CO_2 equivalent annually, all projects, in all locations, must include the consideration of climate-related 'Transition Risks' (as defined by the TCFD) in a CCRA. Similarly, if this threshold is exceeded a greenhouse gas (GHG) alternatives analysis (AA) is also required (according to EP4 CCRA guidance).

Considering the high degree of overlap between the Climate Affairs requirements of the Government of Oman and CCRA assessment requirements of EP4, a CCRA assessment has been prepared and is presented in Appendix D. The CCRA, therefore, is aligned with the Oman Regulations for the Management of Climate Affairs and follows EP4's 2023 Guidance Note for CCRA. As described further in the CCRA, total GHG emissions of the Project fall below the 100,000 tCO_2eq./year threshold; therefore, the Transition Risks and the GHG AA have not been conducted. It should be noted that additional CCRA phases will be undertaken for further considerations for the prospective lenders, particularly for the Physical CCRA.

The results of the Physical Risks part (see Part 1 of Appendix D) indicate that the inherent risks associated with the Project include extreme heat, coastal and extreme rainfall flooding, and extreme winds (tropical cyclones). These risks have been categorized as 'Likely Material - Moderate to High.' The Physical Risks also identifies specific impacts of these risks on various aspects of the Project, such as site personnel, the LNG plant, pipelines, the jetty, site personnel and electricity supply (including the Solar Plant). In addition, it recommends some mitigation measures and further actions to address these risks.

On the other hand, the GHG inventory part (see Part 2 of Appendix D) shows that the resulting emissions from the Project indicate that the threshold defined by the Omani Ministerial Decision No. 20/2018 of 2,000 metric tonnes of CO_2e/y will be surpassed for the Project's emissions during construction and operation: therefore, a Climate Affairs licence will be required. In addition, during the operation phase, with electricity being supplied by the solar plant, the CO_2 emissions per year will fall below of the 100,000 tons of CO_2 eq per year threshold established in the EP4 Guidelines. Since the solar plant will provide electricity to the grid and the LNG plant will consume energy from the grid, the Scope 2 emissions can be considered to be negated provided that sufficient i-RECs are generated by the solar plant, transferred to the LNG plant and retired. Furthermore, a contract will be required with the Omani grid authorities; it is understood this is currently under negotiation. In addition to the carbon reduction measures the Project has inherently embedded in its design, further initiatives to reduce emissions were considered for the Project as required by the Guidelines for the Preparation of Climate Affairs Chapter in the EIA Study for the Projects (2013). These are shown in Annex 3 of Part 2 of the Appendix D - CCRA.

8.9 Accidental and Non-routine events

8.9.1 Introduction

This chapter presents the assessment of accidental/non-routine events (i.e. unplanned events). In the context of this ESIA an unplanned event is an event which is not part of routine operation and that may result in significant environmental or social effects. As described in Section 8.2.5 Methodology of Unplanned Events, unplanned events which are deemed relatively frequent and have non-significant impacts (e.g., small spills) or which are traditionally assessed in routine impacts, even if their frequency and consequences may be significant (e.g. traffic accidents) are assessed under the corresponding routine impacts.

The methodology of assessment of unplanned events is different than for routine events. Besides from the risk-assessment based methodology for unplanned events, given that these have the potential to affect multiple environmental and social receptors simultaneously, the description of impacts is developed according to the source of the risk/impact, rather than by receptor, as used for routine events. As is described in the next sub-sections, unplanned events consequences are classically divided in effects on human health and safety, with a more quantitative and formal approach, and effects on the environment, which is assessed in a more qualitative way.

In terms of sources of risk/unplanned events, the Project is divided in two broad operational categories, as described in Section 3 Project Description:

Terrestrial Operations

- The LNG Plant: consisting of a series of equipment and processes, LNG Trains and related auxiliary equipment aimed to liquefy the Natural Gas inlet and produce LNG.
- The Condensate Export Pipeline: a short pipeline that will supply condensate (a by-product of the LNG Plant production) to the Oil Taking Terminal (OTT) Storage.
- Topside of the LNG Export Jetty: The topside elements required for loading include pipe rack, process manifolds, LNG loading arms, safety means, jetty control station etc.
- Associated Facilities (AFs) to the Project are those infrastructure that would not have been constructed or expanded if the Project did not exist, and without which the Project would not be viable and are part of the scope of the EIA, the one related to the terrestrial side of the project is an extension to the OQGN feed gas pipeline: the existing OQGN network will be extended by approximately 3 km, to feed the LNG Plant with natural gas. The solar plant is another AF of the Project however, considering that there is no direct connection between the solar plant and the LNG plant (solar plant is planned to be constructed in a different plot at an expected distance of 30 km from the port as an offset solution for the Project as it will compensate GHG emissions of the LNG plant), it is not considered as a source of risk/unplanned events.

Marine Operations

- Marine loading operations themselves, including the approach route in and out of the Sohar Port terminal. The new terminal will have the capacity to load LNG bunker vessel sizes between 5,000 and 18,600 m3. It is also proposed that the berthing facility shall be designed for export LNG Carriers up to 185,000 m3, to accommodate to market requirements during the first years of operation.
- As an associated facility, necessary for operation of the terminal, the marine/subsea component of the Jetty, which will be designed and built by SIPC.

The main unplanned events considered in this section are related to:

- Terrestrial Operations: Uncontrolled loss of containment at the plant (described in Section 8.9.2), leading to:
    - Jet, pool and flash fires scenarios across the plant;
    - Overpressure effects in case of an explosion;
    - Cryogenic burns;
    - Toxic dispersion.
- Marine Operations: Vessel Collision, causing a spill (described in Section 8.9.3).

8.9.2 Assessment of Unplanned Events from Terrestrial Operations.

8.9.2.1 Risks to Humans

For assessing risks arising from these operations, MARSA LNG LLC has commissioned three Quantitative Risk Assessments (QRAs), one for each of the three EPC contractors invited to tender for the EPC Phase of the project.

The scope of the QRAs was the same for the three, their main features being:

- An assessment for the FEED stage of the project, in line with MARSA LNG LLC General Standard for Technological Risk Assessment (TRA).
- The scope of the analysis comprised two LNG trains, with the plant under normal operation. It also included all the plant infrastructures and the loading jetty. The feed gas and condensate pipelines were not included in the QRA. They are assessed separately in this sub-section.
- Analysis of risks to personnel from major accident scenarios on the proposed MARSA LNG plant.
- Analysis of risks to personnel due to fires, explosions and cryogenic releases resulting from loss of process containment scenarios, along with the risks associated with occupational hazards.

The results and conclusions of the three QRAs are broadly similar, with some exceptions which are specified below. The summary of the main results and conclusions where:

- Three risk indicators have been calculated: i) Location Specific Individual Risks (LSIRs), ii) Individual Risk Per Annum (IRPA) and iii) Potential Loss of Life (PLL, also expressed as F/N curve[142]). The two first indicators have either or both total and/or regulatory/broadly accepted tolerability thresholds, whereas the third does not, and is used for information and comparison of design, technologies, alternatives or other project circumstances.
- To obtain these indicators, both event frequency/consequence data have been assessed.
- The type of events for which frequency has been assessed are operation related and occupational related. The operation related are “releases” (e.g., natural gas and other substances) of different sizes, from small size leaks to catastrophic LNG Tank failures.
- The frequency assessment in the QRAs is broadly consistent with the respective QRA authors[143] experience from other LNG export facilities and onshore sites; whilst failure frequency analysis is broadly consistent with DNV GL’s[144] experience from other LNG export facilities and onshore sites. For instance, the total release frequency is mostly associated with the smaller release sizes. The frequency of LNG Tank failure has been modelled and is extremely low, as there are no precedents in the industry. Releases in LNG trains account for the vast majority of all releases in the facility, the Loading Jetty being the second source of releases. The largest contributors by material to the total release frequency are natural gas and mixed refrigerant.
- In terms of consequences from these events, considering they are mostly related to LNG releases, are related to fires (e.g., jet fires, pool fires, fireballs and flammable dispersion), explosions and overpressure effects, toxic effects, and un-ignited cryogenic effects. Also included are toxic effects from Hydrogen Sulphide gas (H_2S) associated with releases from the Acid Gas Removal unit and from benzene with releases in Condensate Stabilization unit.
- Hazard distances have been calculated for every loss of containment scenario considered. The hazard distances (with different levels of hazard, from lower flammability limit, to 100% mortality)

[142] FN-curve is a type of risk curve that displays the probability of having N or more fatalities per year, as a function of N, on a double logarithmic scale. It may be used for presenting information about “societal risks” and to depict at least three different types of information: Historical record of incidents; Results of a Probabilistic Safety Assessment (PSA); Criteria for judging the tolerability of risk.

[143] QRAs where developed by: JGC Corporation, McDermott and Technip France SA.

[144] DNV GL is a globally leading quality assurance and risk management company.

from the most frequent/probable scenarios are restricted to tens or hundreds of meters, for the lower level of hazard (an order of magnitude lower for the higher level), all within the plant premises. The highest hazard distance (estimated at 3 km approximately) would be related to a flammable gas cloud from a catastrophic LNG Storage Failure, on a worst case meteorological scenario (e.g. high atmospheric instability such as high winds), and for the Lowest Flammable Level (lower level of hazard). For the higher levels of hazards the distances would decrease consistently to hundreds of meters. It should be highlighted again that the frequency of catastrophic LNG Tank failure has been modelled and is extremely low, as there are no precedents in industry.

- Occupational hazards other than the ones above, from usual activities in plant, and including in some QRAs transport hazards, have also been included and assessed.

Combining, as mentioned, the data from frequency and consequences, the following conclusions about risk indicators have been reached:

Location Specific Individual Risks (LSIRs)

The highest individual risk areas of the facility are the two LNG trains and the jetty head, with Location Specific Individual Risks (LSIRs) in these areas above 10^{-3} per year. LSIR values averaged across the inlet area, process trains and refrigerate storage, are all above 1×10^{-4} per year, mostly related to delayed fires, and the contribution to the risk from toxic effects is small. The LSIR is not the best indicator in terms of acceptability of risk for workers, but it is sometimes used as an indicator for risk to external, third parties outside of plant.

Although not a strict requirement (neither in Omani/International regulations, nor MARSA LNG LLC procedures), there is some consensus in trying to achieve a LSIR of less than 1×10^{-6} per year (at the perimeter of the facility). Nonetheless, in certain jurisdictions, it is considered mandatory if there is permanently occupied human habitation at that boundary (e.g., this is the case in the Netherlands for new facilities; in the UK it is considered broadly acceptable without ALARP demonstration, and, if ALARP can be demonstrated a LSIR below 10^{-4} is accepted).

As building a new industrial O&G facility with a boundary adjacent to permanently occupied human habitation is very unusual, it has not been included in the Total risk threshold in this case, as the site will be within an industrial zone.

It was considered by default at plant design that the LSIR contour of 1×10^{-6} per year would not be outside the industrial zone and therefore outside of permanently occupied areas. In the three QRAs reviewed, the outdoor LSIR at the site perimeter is more than 1×10^{-5} per year at most locations, and thus is higher than the target value. This is mainly due to the distances between the LNG production trains and the site boundaries, which is within many of the hazard distances estimated, and is quite common at similar plants everywhere in the world. Decreasing this level of LSIR to keep it within plant boundaries is usually very difficult, and linked to the fact that the need of a deep port facility, has resulted in those plants being located at the sea end of ports, often in reclaimed land or constructed piers, and as far as possible from human habitations. The sizes of the contours of different levels of risk, and in particular of the LSIR contour of 1×10^{-6} per year, are, according to the QRA authors, broadly consistent with other LNG productions sites, that have been assessed by each of them.

Taking into account that the distance of the plant boundary to the nearest permanent human habitation is actually 2 km towards the south east, it is unlikely that the LSIR contour of 1×10^{-6} per year reaches any identified human habitation, making the risk broadly acceptable and subject to ALARP demonstration at the worst. It is suggested that this circumstance be confirmed in subsequent phases and iterations of the QRAs and plant design.

Individual Risk Per Annum (IRPA)

Values for all worker groups on the facility are between the 10^{-3} per year IRPA tolerability limit, and the broadly acceptable limit of 10^{-6} per year, in the ALARP region, as outlined in MARSA LNG LLC procedures, adding the occupational risk does not change this conclusion.

Similarly, to the previous indicator most of the IRPA comes from operational production hazards rather than the general occupational hazards. Conclusions are also similar to previous indicator (but in this case focused on risks to workers) with estimated risks being broadly within the ALARP region.

As in the case of the previous indicator discussed, it is suggested that this circumstance be also confirmed in subsequent phases and iterations of the QRAs and plant design.

Potential Loss of Life (PLL), also expressed as F/N curve

This indicator is less consistent in results amongst the three QRAs, in any case there are no commonly accepted or MARSA LNG LLC corporate acceptability thresholds for it. The PLLs range between 0.11 per year (which equates to one fatality every six years, with a significant contribution to PLL from occupational hazards (42%)) in one QRA, to a much less severe level in the other two, up to one order of magnitude less, 10^{-2}, or one fatality every approximately 40 years, with a marginal contribution of occupational risks. The reason for this discrepancy may be the occupational hazards, and the contribution/exclusion of transport hazards in these, but it remains largely speculative.

The aforementioned review and iteration of QRAs and plant design on the previous two indicators, planned and already being implemented by MARSA LNG LLC, will result in an improvement in this indicator in parallel.

As mentioned at the start of this section in regard to the scope of the existing QRAs, they did not include the pipelines, the feed gas and the condensate product; and thus these are described briefly.

- For the condensate product, being the transported substance a liquid at normal temperature and pressure conditions, the hazards associated with these pipelines, in terms of accidents with consequences to human health and safety, are much lower than from pressurised gas pipelines of LNG handling. In any case, it is planned to include this infrastructure in the next iteration of QRA and plant design.
- The feed gas pipeline is an extension to the general OQGN feed gas pipeline to the industrial estate. The existing OQGN network will be extended by approximately 3 km, to feed the LNG Plant with natural gas, all to be built within the industrial area. MARSA LNG LLC will request the relevant safety and risk information from OQGN when available, to make sure it complies with applicable regulations and internal corporate standards, as it is an associated facility to the MARSA LNG LLC operation.

8.9.2.2 Risks to the environment

As mentioned in the Methodology sub-section (Section 8.2.5), the more frequent and lower consequence spills and leaks of chemicals within the plant and from vehicles and equipment as well as from waste and hazardous material management are assessed in the routine impacts' sections of this report (see Sections 8.6.3, 8.6.4 and 8.6.5). The relevant accidental events to be included in this section refer to leaks and spills of LNG, refrigerants or other substances of different magnitudes. The discussion and conclusions referred to the frequency/probability of such events are applicable and fully relevant for this kind of effects as well; what differs significantly are the consequences, both from the leaks themselves as for the associated fires, explosions, toxic and cryogenic effects.

LNG spills in land are expected to evaporate/boil off according to ambient air temperature quite quickly, producing a local soil cryogenic effect as well. Even the worst case scenario of a massive LNG tank failure will not affect any sensitive environmental local receptor such as local air quality (as methane (CH4) would disperse quickly), surface water or biodiversity (the latter two due to lack of receptors) and the fact that a potential LNG leak is collected and diverted to an Impounding Basin within which LNG will vaporize). The only effect worth mentioning would be the contribution to greenhouse gases from methane boil-off. Methane is a greenhouse gas that is roughly 27 times more potent as a heat-trapping gas than carbon dioxide. However even the marginal probability of a massive tank failure would represent a “one off” situation with a total greenhouse effect that would be insignificant in relation to the routine operation of the whole industrial area surrounding the plant. Leaks of other substances, as mentioned in the QRAs, would also have marginal effects on practically inexistent receptors, in this case other liquid substances which could penetrate the reclaimed land, would end in adjacent seawater body, not used for supply, limited density/diversity of living organisms and low transmissivity towards open sea water.

Indirect effects of fires and explosions on air quality would be of minor consequence, as it would be natural gas combustion, and the produced NO_X for instance would rapidly disperse. Direct effect of mortality of flora and fauna is not expected due to the low density/diversity of such receptors within the maximum area of influence of the identified hazard.

Therefore, given the relatively low consequences and very unlikely probability, the risk is deemed acceptable.

8.9.3 Assessment of Unplanned Events from Marine Operations.

8.9.3.1 Risks to Humans

The operation of the jetty on the terrestrial side (i.e., operation of the loading jetty and loading arms) has been included in the QRAs discussed in Section 8.9.2.1. This section includes only the operation of the vessel side, when approaching in and out of the mooring and when being loaded with LNG. No re-fuelling of diesel for vessel engines is expected to take place in Sohar port, or at least in the LNG terminal, thus it is not included in this assessment.

No formal QRA has been developed for this part of the project, and it is not in principle planned to be developed. What follows is an ERM generic assessment based on available literature and precedents.

The LNG marine transport industry has so far not had any major accident involving spills of LNG from vessels accidents (i.e., collisions, groundings, fires and explosions etc.). There have been however concerns related to the potential of third party violent interaction with vessels when in route or port, which could result in this kind of events.

The consequences of such type of event and associated potential massive LNG spill on water have yet not been able to be empirically studied (i.e., such event has never occurred), and their assessment comes from theoretical studies and models. There is however sufficient information about the characteristics of LNG and its behaviour to predict such consequences with relative certainty.

Possibly the most comprehensive model and study undertaken so far is the “Sandia report”[145]. In 2004, the US Department of Energy (DOE) commissioned the Sandia corporation to develop a risk-based analysis approach to assess and quantify potential hazards and consequences of an LNG spill from an LNG carrier (LNGC vessel). Sandia utilized previously completed studies and conducted its own studies to determine the hazards of an LNG spill. Sandia also developed risk management strategies to minimize the likelihood of an incident. The 2004 Sandia report is typically used as the industry standard and benchmark on which to base project-specific risk assessment studies. Because of the increasing size and capacity of many new LNGCs, at the request of the DOE, Sandia conducted a detailed report on breach analysis (Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers (Sandia 2008)), conducting a series of large-scale LNG fire and cryogenic damage tests, as well as detailed, high performance computer models and simulations of

[145] Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water. Sandia National Laboratories. SANDIA REPORT SAND2004-6258 December 2004.

LNG vessel damage resulting from large LNG spills and fires on water. The DOE 2012 Report to Congress on Liquefied Natural Gas Safety Research, was the result of such studies.

The main results of these studies relevant to the project situation are as follows:

- In general, the worst-case LNGC breach scenario with hazards to public safety and property would be within approximately 2 km of a spill, with minor damages reaching as far as 6 km. This worst case scenario involved a three-tank simultaneous release, of an LNGC vessel of 265,000 m^3 capacity. Similar to the terrestrial worst case scenarios, those distances are relevant to the scenario of natural gas vapour migration to another available ignition source, in the direction of prevalent wind.
- The probability of such worst case event occurring is extremely remote, considering there is a low probability of the initiating event (i.e. the third party interaction) occurring; on the other hand the current LNGC vessel and cargo tank design, materials, and construction practices are such that simultaneous, multi-cargo tank cascading damage spill scenarios are extremely unlikely.

Applying these conclusions to the project case there are several considerations to be made:

- The probability of a collision while in route is generically extremely low, in the case of this project comparing the in and out of port routes traffic intensity (approx. 70 port calls per week) compared with the increased planned traffic by the project (one per week), means an increase of less than 2%, thus the added collision risk is minimal.
- The maximum distance of effects shall be considered related to the location of the event. If a third-party interaction takes place when the vessel is in route, the distances to the coast and thus potentially inhabited locations will be higher. The shortest distance to coast and inhabited areas would occur while moored and once it is fully loaded and set to sail away. That distance is estimated at 2.5 km to the nearest permanently inhabited area. Also, the maximum capacity of the LNGC vessels, similar to the one modelled in the Sandia report, will be used only during a transitional period, until the bunker vessel market is consolidated. From that period onwards, the maximum capacity of the vessels will be up to five times lower, decreasing from that date the maximum hazard distance.
- The probability of the event occurring while in port is lower than in route. In the Sandia report it is specified that amongst the risk management strategies to reduce potential LNGC vessel vulnerability and damage from breach events that can result in large spills and fires include implementation of enhanced port operational security measures, review of port operational contingency plans and review of emergency response coordination and procedures. In this respect it has been publicly reported that SOHAR port has recently entered into an agreement with Unity Fire & Safety Services LLC, for the management of the Sohar Emergency Response Organisation (SERO). Another logistic factor of consideration is the time spent in port with LNG in the LNGC vessel; it would take approximately two days for full loading of a large LNGC and one day to fully load a bunker vessel. The waiting period while mooring in and loading would be with an empty vessel, while the waiting period between loading finalization and sailing out would be kept to a minimum, as there is an obvious commercial incentive to leave port as soon as possible.

Therefore, considering the relationship between consequence and probability, the consequences would be serious at the most, as the worst-case scenario major hazard would not reach the 2,5 km distance to the nearest inhabited area, being at the most within the 6 km area where minor damages may occur, and only for the temporary maximum capacity LNGC vessel operation, and on the other hand would be of extremely unlikely probability, thus acceptable or conservatively ALARP.

The potential risk reduction strategies applicable identified by the Sandia report, apart from the enhanced port safety and security, are the review and improvement of LNGC vessel design, equipment and operational protocols for improved fire protection. These are expected to have been applied to the new LNGC vessels since the publishing of the Sandia report, and specially for new bunker vessels, thus enhancing the acceptability of the risk.

8.9.3.2 Risks to the environment

As with the terrestrial QRAs the discussion of the probability of events is similar as described for the risks on humans. The probability of spills while in route or in port is as previously mentioned, extremely low.

In terms of consequence there are two main substances which could be spilled, diesel oil as LNGC vessels and bunker vessels are dual fuelled (diesel in general, with some large LNGCs using bunker oil), and natural gas.

The consequences of a diesel spill would be different depending on location of the spill, if in transit diesel is volatile and spreads, evaporates and dissolves rapidly on an open ocean environment. The effects will be localised and temporary. Depending on location of spill and metocean conditions, the spill could reach the coast, with varying effects depending on quantity and state of the material reaching the coast and characteristics of the receiving coast. In any case, even in the event of a massive diesel spill reaching the coast, the consequences would be very serious at the most, as diesel degrades faster than other materials. If the spill is within port, the logistic consequences could be significant, but the environmental consequences would be moderate. In all cases as the probability is extremely unlikely, the risk is acceptable.

The consequences of an LNG spill on sea water environment are mainly related to the cryogenic effect as a cryogenic liquid, LNG quickly cools the materials it comes into contact with. The thermal inertia of water makes the cryogenic effect to be localised within small distances both horizontally and in depth. Also, the “Rapid Phase Transition” phenomenon implies that there will be localised high concentration of methane displacing air from the surface and the air water interphase. Potential impacts to marine organisms would include exposure to low-temperature LNG at the water surface, possibly resulting in frostbite or death and asphyxiation by natural gas vapours above the surface of the water. These transient impacts would likely occur in the immediate vicinity of the spill location. Since LNG would boil off as natural gas at the surface, depth and pressure required for gas to dissolve in surface waters would not be sufficient and gas vapours would disperse. In addition, the time frame for these impacts would be limited, and adverse toxic impacts would be expected to be minor after the LNG boiled off and the vapours dispersed. Also, the density/diversity of marine organisms in general is very low within the port limits (with exceptions such as when plankton blooms may occur or reproduction /feeding/migration of marine organisms takes place) decreasing the probability of marine biota present at and when the spill takes place. In terms of methane boil off as greenhouse gas, the same applies as discussed with an LNG spill inshore in the previous section; even with a massive LNG spill the one-off methane emission of such event is not comparable with routine greenhouse gas emissions from routine sources.

The environmental consequences within the immediate environs of the spill, although of a very different nature, one cryogenic and the other toxic, would be of an equivalent degree in orders of magnitude, possibly higher in the case of an LNG spill. However, an LNG spill would evaporate immediately and intrinsically would not reach the coast, thus the magnitudes (intensity and geographical extent) compensate each other, and as the probability of both is extremely unlikely the risks are acceptable.

8.9.4 Mitigation measures

Mitigation measures for unplanned events, necessary to guarantee ALARP for the terrestrial operations, are linked in the QRAs to address risk reduction measures on human risks. These reduction measures are being investigated and assessed by MARSA LNG LLC through Risk Reduction workshops and iterations of the QRAs as the project design phases advances, and will be included in the project design and management in due course. The aim of these is to reduce the residual risks, similarly to the routine impacts, to an acceptable level, or if not possible to ensure ALARP level.

8.10 Cumulative Impacts

8.10.1 Introduction

The aim of this section is to present the results of the Rapid Cumulative Impact Assessment (CIA). As explained in Section 8.3.3., the objective of a Rapid Cumulative Impact Assessment (RCIA) is to determine a) if the execution of the Project has the potential to contribute significantly to the cumulative impacts on Valued Environmental and social Components (VECs), and 2) if the viability of the Project may be at risk from cumulative effects on the VEC it depends on.

The main steps carried out for the analysis are:

- Identifying other existing, planned and future Projects that could cause cumulative effects;
- Identifying the VECs that could be cumulatively impacted;
- Evaluating the cumulative impacts on the VECs;
- Develop a framework for the management of cumulative impacts.

This assessment follows the approach outlined by the IFC Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (overall approach is summarized in Section 8.3.3)[146].

This assessment is focussed on potential cumulative effects on VECs adversely impacted by significant Project impacts only (i.e., Minor, Moderate or Major) as part of the preceding assessment. Other VECs have been scoped out from this assessment on the grounds that the Project will not significantly contribute to any cumulative effects.

The information review involved desk review of available information, including existing ESIAs, and on-line public information, with no additional site visit or stakeholder consultation. Thus, the scope of the assessment takes into account the typical limitations that a Project developer may face in this type of evaluation, including:

- Uncertainty associated with other currently operating or anticipated developments
- Lack of detailed VEC baseline information in relation to other developments;
- No third party / stakeholder inputs into the CIA process;
- Incomplete information about other Projects and activities (for example, if the information is not available in the public domain);
- Lack of provincial strategic plans, or integrated resource planning schemes.

8.10.2 Application of the RCIA methodology

8.10.2.1 Scoping Phase 1: Identify VECs, Spatial and Temporal Boundaries

The spatial extent of any cumulative impacts will be confined to the direct and indirect area of influence of the Project.

[146] There is no fundamental conceptual difference between a RCIA and a CIA; the first is a simplified version of the second. The preliminary screening exercise resulting from a RCIA may evolve into a CIA. The only difference in practice is that typically an RCIA involves only a desk review of available information, including existing ESIAs; strategic, regional, and/or resource planning documents; and reports from nongovernmental organizations (NGOs), the scientific community, and other interested actors. A CIA is likely to involve a complex governance structure and consultation with several parties and stakeholders to determine the VECs to assess, the baseline data requirements and sampling methodology, acceptable future conditions of VECs, indicators and thresholds, mitigation measures, monitoring protocols, and supervision mechanisms.

The temporal scope of any cumulative impacts will be the same temporal scope covered by the Project and its three phases. As the most significant impacts from the Project will occur during the operation phase, this will also be the period when the potential for significant cumulative impacts is highest.

VECs are environmental and social components valued by beneficiaries and considered as the final recipients of cumulative impacts. To be included in this assessment, it must first be demonstrated that at least one stakeholder values an environmental and social component, be it a national, regional or local group, national or international scientific community, etc.

VECs are environmental and social attributes that are considered important in assessing risks; they may be:

- Physical features, habitats, wildlife populations (e.g., biodiversity).
- Ecosystem services (e.g., natural fish production)
- Natural processes (e.g., water and nutrient cycles, microclimate).
- Social conditions (e.g., health, economics); or
- Cultural aspects (e.g., traditional spiritual ceremonies).

While VEC's may be directly or indirectly affected by the Project, the cumulative effects of several other Projects often also affect them. VEC's are the ultimate recipient of impacts because they tend to be at the end of ecological pathways. Thus, the VEC's must be affected by both the Project and a combination of other Projects. If any VEC were affected by the Project, but not by the Other Projects or vice versa, the VEC would not be included.

This identification has been done using both the technical identification and approach in the different sections of this ESIA (physical-biological, socio-economic, cultural heritage and ecosystem services) giving priority to those VECs that are likely to be at the greatest risk from the development's contribution to cumulative impacts. On the other hand, the results of the baseline stakeholder engagement meetings carried out in 2019 have been taken into account, which mainly highlighted concerns arising from cumulative impacts relating to air emissions. Other concerns referred to the expansion of Sohar Port South and its associated indirect impacts on fishing activities.

The receptors and resources affected by significant adverse impacts from the Project were assessed to determine if they are considered to be a VEC. Table 8-36 sets out this evaluation.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Table 8-36 Identification of VECs

Environmental / Social Variable	VEC?
Air Emissions	**Yes – physical features**
Climate change	**Yes – physical features**
Noise	**Yes – physical features**
Soils	No The Project LNG Plant will be built on reclaimed land, created for the sole purpose of industrial development. On-site land improvements will be necessary if fill material from dredging is not fit for purpose and will be carried out only in areas where higher load bearing specifications are required to support heavy structures (e.g., storage tanks) and equipment (e.g. turbines and compressors) will be installed. The transmission line and both pipelines are outside of the reclaimed area and the soil at the level of their corridor routes have been extensively disturbed and modified by the installation of existing industrial pipelines. The Project does not require any take of existing land, land acquisition or any change to existing land use in adjacent areas; all project activities will be carried out within the boundaries of the SIPC Concession area. Appropriate hazardous materials and waste management as well as wastewater management and disposal will be carried out, in line with the Waste Management Plan. Soils are not considered to be an important aspect of the cumulative impact assessment.
Water Resources – groundwater and surface water	No The Project will not draw on groundwater resources or surface water resources. Potable and process water will be supplied by a third party in the Port from desalinated sources. The Project will use the existing storm water drainage system of the Port. Appropriate hazardous materials and waste management as well as wastewater management and disposal will be carried out, in line with the Waste Management Plan. No other excavations similar to the ones planned by the Project for the transmission line and both pipelines construction and decommissioning are known to be planned by other industries. Water resources are therefore not considered to be an important aspect of the cumulative impact assessment.
Landscape and Visual	No While the proposed further industrialisation of the area would result in an incremental increase in the visual impact to the neighbouring communities who are accustomed to the industrial development of the Sohar Port Industrial Estate. The visual impact of the development is therefore not considered to be an important aspect of the cumulative impact assessment.
Terrestrial Ecology and Habitats	**Partially** As the development will occur on reclaimed land there will be a negligible impact to general terrestrial habitats or species after appropriate mitigation measures are implemented. However, the Project is located in an Important Bird Area covering the shoreline of the Governorates of North and South Al Batinah. Apart from the cumulative impact to this IBA, the impact on terrestrial habitats and species arising from the development is not considered to be an important aspect of the cumulative impact assessment.
Seawater and sediment quality	**Yes – physical features**
Marine Ecology and Habitats (including Protected species)	**Yes – biodiversity**
Local economy and employment	**Yes – social conditions (economics)**

Environmental / Social Variable	VEC?
Community Health and Safety	**Yes – social conditions (health)**
Unmet expectations and benefits	**Yes – social conditions**
Social Infrastructure and services	**Yes – social conditions**

Following this review, the CIA will focus of the following VECs:

- Air emissions, GHG emissions and Noise emissions
- Seawater and sediment quality
- Terrestrial Ecology and Habitats: Al Batinah Coast Important Bird Area
- Marine Ecology, Habitats and Protected species
- Social conditions.

8.10.2.2 Scoping Phase 2: Identify other activities and environmental drivers

The Project area is located in the Sohar Industrial Port (SIP) which is associated with the Sohar Port Industrial Estate and Freezone (SIPC and SFZ), Sohar Industrial Estate (SIE), and Sohar Airport (Figure 8-13, Figure 8-14 and Figure 8-15). The Sohar Industrial Port Company (SIPC), a collaboration between the Ministry of Transport and the Port of Rotterdam manages the SIP, SIPE and SFZ, while the Madayn (Public Establishment for industrial Estates) manages the SIE. The airport opened to international travel in 2017 and is designed to integrate with the local highway (and forthcoming development of the GCC railway network) to enable Sohar's eventual transformation into a major industrial and logistics hub. Commercial and industrial activity by more than 35 companies operating in a range of sectors from logistics, to petrochemicals, to metals, to automotive and food production have enabled local economic growth. Sohar is one of the most important centres of economic growth in Oman due to its track record and high potential for attracting foreign direct investments (SIPC, 2019).

The SIP is being developed through its Sohar Port South (SPS) expansion project which will ultimately add 2,200 ha to the land area available for industrial activity. SPS is just part of a strategic plan to expand and enhance activities at Sohar Port in five major phases, but plans to initiate SPS have been put on hold. In 2006, Phase 3 deepened the approach channel and converted the fishing harbour to industrial use. Reclaimed land was developed into Terminal 2D (75 ha) in 2008 and in 2019 the first 50 ha of SPS was reclaimed adjacent to the southern face of the southern breakwater (Figure 8-14), providing land on which the Project will be built as part of Sohar Port South Phase 1. Further expansion of SPS has no firm schedule and is currently on hold (Figure 8-14).

All land reclamation has and will be undertaken by SIPC as part of the possible future development of SPS and while it is not being considered as an element of the Project reclamation work will contribute to the cumulative impact arising from the general development of the Sohar Port area.

Industrial developments in the Sohar Port area include

- The Liwa Plastics Industries Complex which was successfully completed by end 2021 and is now operational. It is expected to add 127 container vessel movements to SIP's marine traffic flow.
- Sohar Titanium Company (Titanium dioxide plant): located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in November 2022, under construction as of July 2023, operations expected to commence in 2025;

- A Petcoke Calcination Plant located in the Freezone area, around 10 km from Marsa LNG plot, which has commenced its commissioning phase;
- A rail connection between Sohar Port area and Buraimi is planned and is currently being tendered for detailed design and construction. No publicly available information is at the time of writing.

Industries in the Sohar Port Area whose construction has not started yet or that are in the pre-feasibility stage are:

- Sohar Steel Rolling iron and steel manufacturing: located in the Freezone area, around 10 km from Marsa LNG plot, agreement signed in June 2022; construction has not started yet;
- Arkan Sohar Logistics Container Freight Station (CFS) and logistics complex (warehouse facility): agreement signed in 2022 but timeline of construction was unknown at the time of developing this report;
- Hydrogen plant at Sohar, inside the exiting Jindal Shadeed facility, which will decarbonize the steel production process of Jindal Shadeed´s iron and steel manufacturing plant; construction timeline unknown;
- GCC rail network in Sohar connecting Oman to United Arab Emirates: agreement signed in 2022; construction planned to commence in 2024;
- Trescorp oil storage and export facility: pre-feasibility stage;
- Sohar Port and Freezone Solar PV Park with a capacity of 975MW: pre-feasibility stage;

Significant renewable energy developments such as photovoltaic (PV) projects of 10-40 MW_{ac} are planned to cover 600 ha of the SIP and SFZ. A 25-megawatt solar plant was built in 2021 in the Sohar Freezone[147].

Terminal 2D (Sohar East) will likely be leased to steel and logistics industries and a 45-ha strategic food mega-cluster is underway and will includes a flour-mill, a future sugar refinery, and a grain silo complex. In parallel, downstream industries of food production (including cold storage and warehouses) are planned in the SFZ.

Other potential (but uncertain) future projects may include a new express road between Sohar Port and Riyad (Saudi Arabia), as well as future expansion of Sohar Airport. More certain is the rail network connecting key hubs in the GCC is progressing, as agreements have been signed for the implementation of a railway network linking Sohar Port with the UAE national railway network. This project is not considered in the cumulative impact assessment as the start date of construction is not yet confirmed, but this project is currently in tendering stage. Under earlier masterplans for the GCC rail network Sohar would have been a major node carrying both freight and passengers from Oman to UAE and beyond via Buraimi.

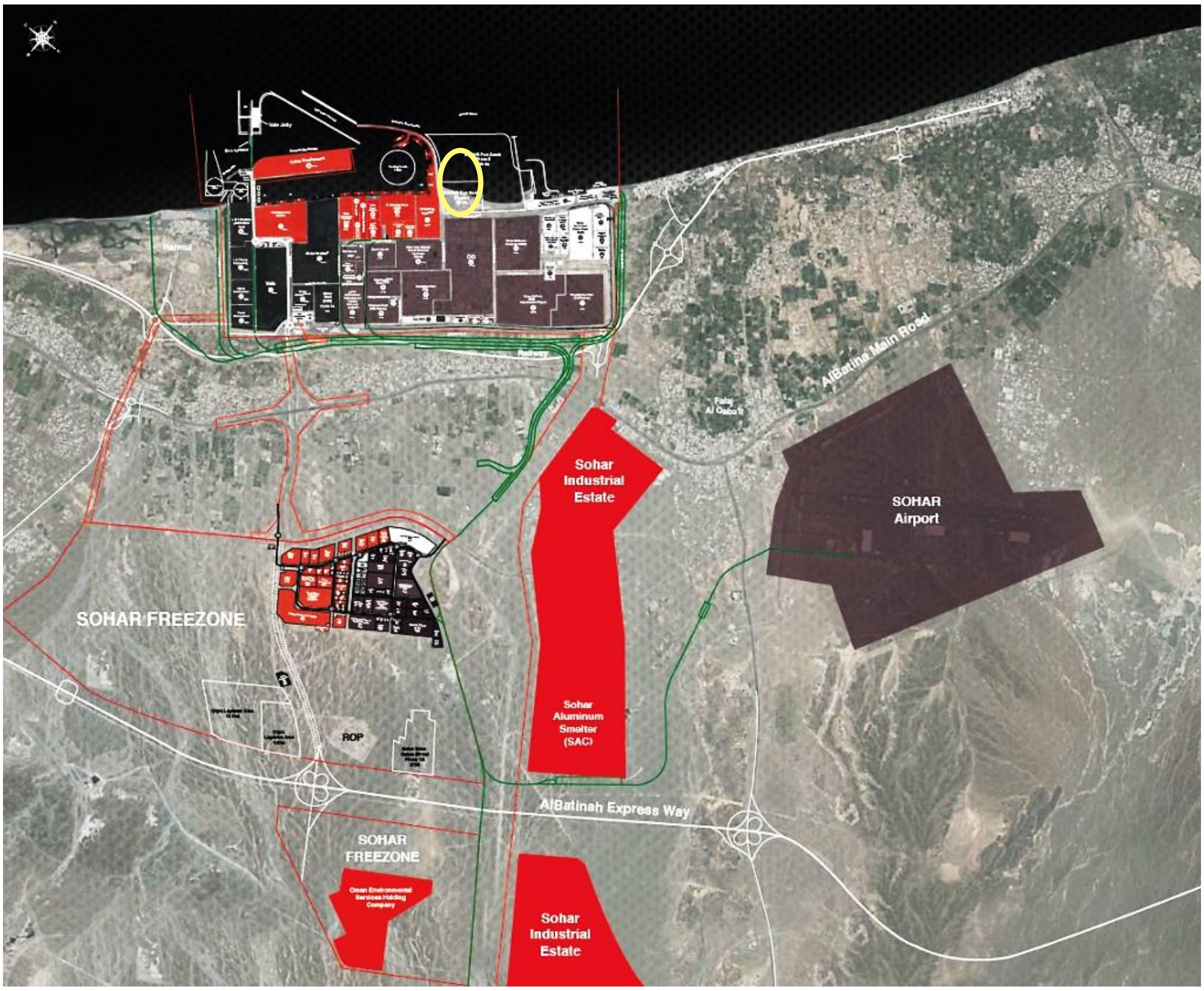
There are no specific significant natural risks predicted for the long term, apart from the Project’s vulnerability to climate change which will most likely include: extreme heat, coastal and extreme rainfall flooding, extreme winds (tropical cyclones), and water stress and drought.. These are assessed in Section 8.5 and in Appendix D – Part 1.

On the other hand social external influences on the Project area for the long term are expected to be high, in a context that the Sohar Port and Free Zone has long-term development outlook which forecasts future potential growth with investments of US$ 44 billion, cargo volume throughput of 238 million tons and 57,000 direct jobs by 2040.

[147] https://www.shell.com.om/en_om/media/2021-media-releases/shell-launches-25-megawatt-solar-plant-in-sultanate-of-oman.html

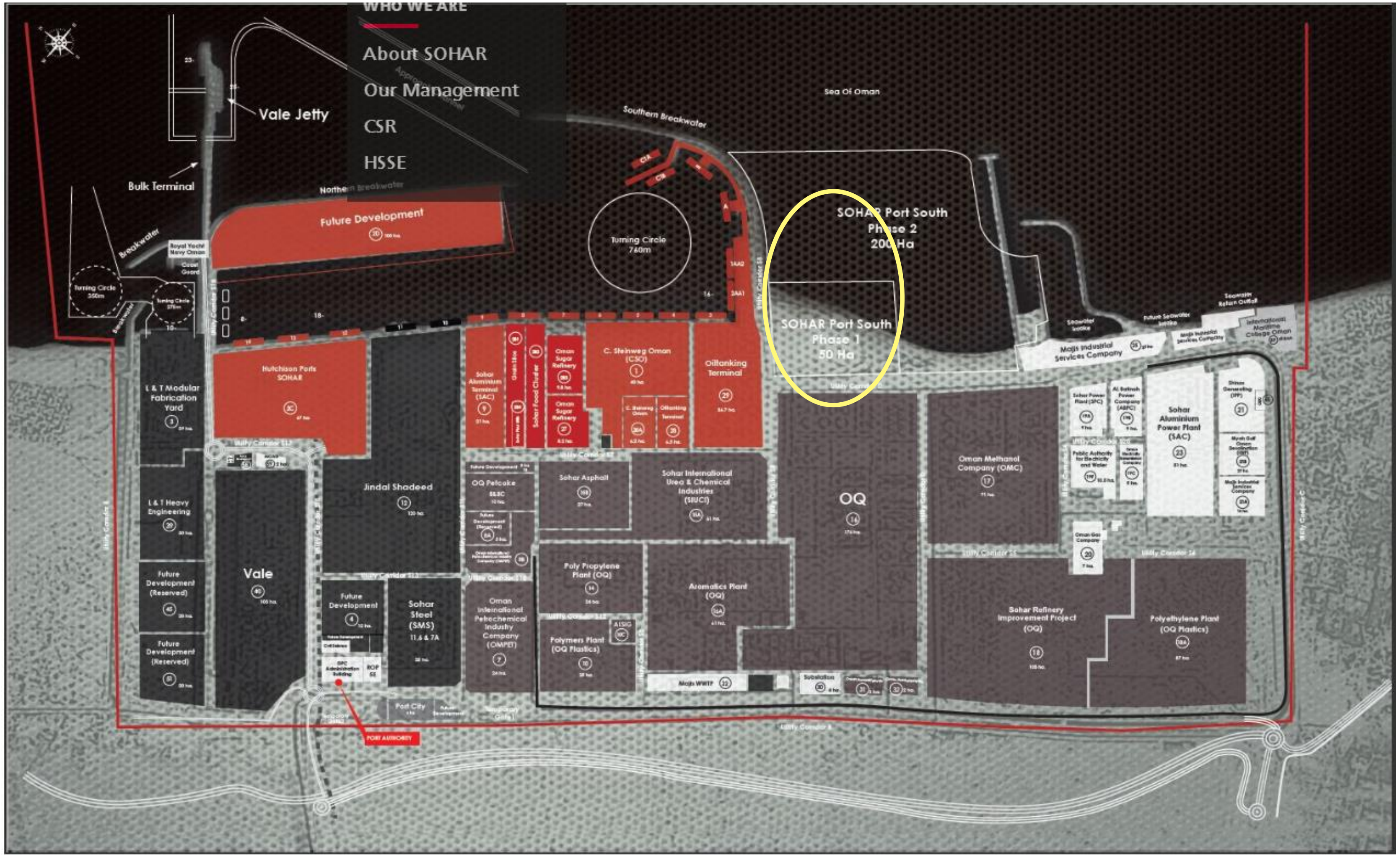
The developments described above in this section have been included in the cumulative impact assessment based on available information. It is expected that these planned and future projects will overlap in time and in space with the Project (mostly during the operation phase of the Project).

As described in Project Description, a solar plant, considered as an associated facility to the Project, is planned to be constructed in a different plot outside the port. It is going to be built as an offset GHG emission solution for the Project. The exact location of the solar plant is unknown at this stage however it is expected to be constructed at approximately 30 km from the port. While the start-up of the solar plant shall be aligned with the LNG plant start-up, considering no direct connection between the solar plant and the LNG plant foreseen, the distance between the two and the fact that the two projects will not use the same resources (materials nor human) during its construction phases nor subsequent phases, this development is not included in the cumulative impact assessment. However, the solar plant's impacts and mitigation measures, once assessed as part of a separate ESIA, will be considered by the Project's E&S Management System to ensure any interferences or overlap in the management of both facilities are taken into account.



Note: The yellow circle shows the approximate Project location.
Source: SIPC, 2023

Figure 8-13 Sohar Industrial Port in relation to nearby areas of development



Note: The yellow circle shows the approximate Project location.

Source: Sohar Port and Freezone (https://soharportandfreezone.om/en/soharport/portifno/port-map)

Figure 8-14 Location of Sohar Industrial Port and surrounding industries

Note: The yellow circle shows the approximate Project location.

Source: SOHAR INTERNATIONAL DEVELOPMENT COMPANY LLC, Land Reclamation ESIA, 2019

Figure 8-15 Detail of Sohar Industrial Port, Freezone and surrounding areas of development

8.10.2.3 Assess cumulative impact on VECs and evaluate their significance

The aim of these steps in the assessment process is to describe the impact on resources and receptors and determine the potential significance of a cumulative impact, taking into account the magnitude of the potential change and the sensitivity/ vulnerability of the receptor to such changes in the context of past, present, and future actions, and to identify trade-offs. As part of the ESIA, the baseline conditions of resources and receptors that have the potential to be affected by cumulative impacts has been established (Section 4, 5 and 6). This included the collection of primary and secondary data to determine the existing conditions and the vulnerability/ sensitivity of the receptor.

Being limited by the information available in the public domain and the information generated by existing environmental and social studies, the cumulative impact assessment is presented as a qualitative and descriptive exercise.

- **Major Priority:** it is necessary to take action in the short term to mitigate the adverse cumulative effects, considered of greater significance, which are currently occurring on the VEC and that the Project would contribute,
- **Medium Priority:** action is required in the medium term to mitigate the potential adverse cumulative effects that could occur on the VEC and,
- **Minor Priority:** no action is required, since the expected cumulative adverse effects on the VEC are considered less significant.

Air emissions

Cumulative air quality impacts would be related to the in-combination effects of the Project's air emissions with existing emission sources and planned emissions in the immediate area around the Project site, which could result in an elevation of ground level concentrations of pollutants and have an impact on the health of workers and local communities. Considering the baseline conditions (below the limits set by the normative for all the pollutants) and the modelling results, which highlighted that the contribution of the Project to the ground level concentrations of pollutants is negligible, the cumulative impacts on air quality are expected to be of **minor priority**. As such, no additional measures are proposed to manage cumulative effects.

GHG emissions

The accumulated increase in greenhouse gas emissions could be considered as a significant risk, considering the simultaneous operation of all the industrial projects currently operating and planned in the area during the construction phase and the expected lifetime of the LNG Plant of 25 years.

However, considering that the solar plant planned to be constructed will be an offset solution for the Project as it will compensate GHG emissions of the LNG plant, the LNG plant GHG emissions Scope 2 emissions will be significantly reduced. The solar plant's overall production on a yearly basis will be equal to the LNG plant's electrical consumption, allowing to fully compensate the LNG plant's Scope 2 emissions.

As a cumulative impact, for Scope 1 and 3 emissions only, it is considered as a **minor priority**: the operation of all identified developments within the Sohar region are likely to give rise to an increase in the regional and national GHG emissions, while at a global scale these will not be considered significant.

Noise

The cumulative emissions of noise could cause ambient noise levels to be raised above the current noise levels and also cause an additional nuisance to nearest receptors (i.e. settlements). Noise effects are: sleep disturbance, an increased incidence of social and behavioural problems (including annoyance and increased aggressive behaviour) and in extreme cases, hearing impairment.

Considering the high background existing noise levels (ranging from 63 to 66 dB(A) during the daytime at the nearest settlement of Majis located at more than 2 km from the site as per 2019 baseline measurements), and the close location of the surrounding industries currently in operation at the Sohar Port, and that the Project's contributions to any such cumulative effects are and will be minimised as much as feasible (as part of the Project's embedded controls and proposed mitigation measures), the cumulative impacts on noise are expected to be of **minor priority**. As such, no additional measures are proposed to manage cumulative effects.

Al Batinah Coast Important Bird Area

The Project site, existing and planned developments are/will be located within the Al Batinah Coast IBA, and is close to the Khawr Shinas, Khawr Liwa and Sun Farms IBAs, as so birds might be impacted by the cumulative effects. Such cumulative impacts include: induced mortality associated with bird migration and/or movements and disturbance due to potentially increased noise levels, potentially increased levels of air pollution, and increased light pollution. The key sources of such impacts include emergency flaring and industrial lighting of the plant to illuminate the facility at night.

Bird species currently using the Project area are not considered threatened (i.e., they are of 'least concern' IUCN, 2020). However, populations of the Lesser Sand Plover (*Charadrius mongolus)* and the Kentish Plover (*Charadrius alexandrinus*) are under 350 individuals and are at risk of being significantly reduced over the next five generations (IUCN, 2020). Since the area is already heavily industrialized, it is considered that birds are already habituated to the high level of industrialisation and would in any case avoid it. Mitigation measures include the establishment of a bird monitoring program in coordination with SIPC and other industries with potential negative impacts on birds (such as other industries that carry out flaring activities). In addition, the Project design will consider: reducing LNG plant lighting at night (e.g. incorporating red lights and motion sensing) to reduce additional light emissions. Bird reflector deterrents will also be considered for placement near infrastructure that can harm birds (e.g. flare and waste storage).

This cumulative impact is considered of **medium priority**.

Seawater and sediment quality

All storm water (and wastewater generated by wash down or fire control) arising inside the battery limit will be collected and sent to a third party wastewater treatment facility. The only discharges to the marine environment are associated with storm water drainage from service roads and the common utilities corridors (pipeline alignments and easements along roads) and these assets will remain under the responsibility of SIPC.

In terms of discharges from vessels (i.e. operational spills and discharges from ships), the main impact arising is the risk of seawater pollution and the downstream effects on: i) marine ecosystems and ii) infrastructure (i.e. MISC's seawater intake system) and economic activities based on those. In terms of cumulative impacts of the components, similar types of discharges can be generated by other vessels which can be coincidental in time and/or geographical location in some instances. In this context, discharges from vessels, due to compliance of relevant agreements and regulations (i.e. MARPOL and national legislation) suggest a non-significant additional source. However, final effect on marine water quality depends on dilution/dispersion capacity of the surrounding marine environment. Considering the low probability of simultaneous vessel discharges in the area, the probability of cumulative impacts of the Project in this respect is considered low.

Considering the above and in light of the Project's recommended mitigation measures detailed in Section 8.6.8.4, such cumulative effects are considered as a **minor priority**. As such, no additional measures are proposed to manage cumulative effects.

Marine ecology and habitats (including protected species)

Two aspects are taken into consideration to assess the cumulative impact of the Project with respect to marine ecology and habitats.

Invasive species risk

The increase vessel movements will incrementally increase the risk of introducing marine invasive species. The two most likely pathways for this to occur are hull fouling and ballast water.

All vessels however will be required to comply with the international convention for the management of ballast waters and sediments. Nevertheless, currently there are no measures in place in Oman to assess or control the risk of introduction of invasive species from hull fouling or the residual risk arising from ballast water discharges.

Additionally, when calculating risk it is important to recognise that the consequences of introducing a highly invasive marine alien species must be assessed by taking into consideration the consequential economic damage to the common seawater cooling system (operated by MISC) as well as that to all tenants drawing from the MISC common seawater supply system, which constitute another receptor apart from the marine ecology and habitats. The sensitivity of the MISC common seawater intake system to increased fouling potential is considered high because i) intake systems are prone to macro-fouling by marine organisms that occur in the natural environment and this susceptibility would be exacerbated by fast growing, invasive species and ii) the seawater system serves multiple industries that critically depend on seawater for cooling and as a source of raw water for desalinating.

The invasive species risk is considered to vary between minor to medium priority, since there are compliance requirements to avoid associated impacts but there may be a residual risk that needs to be addressed, especially considering the high sensitivity of the MISC common seawater intake system. Recommended mitigation measures have been proposed in Section 8.6.9.4 and include the development of a Ballast Management Plan and an Alien Invasive Species Management Plan where it is recommended that MARSA LNG LLC engage with SIPC to carry out a risk assessment of invasive species risk at the Sohar Port and based on the results, act with SIPC and other relevant developments on any recommendations arising.

Vessel strikes and underwater noise

The incremental increase in ship traffic arising from Project activities will proportionately increase the risk of strikes to marine wildlife, particularly cetaceans and marine turtles. Both groups are vulnerable to ship strikes while cetaceans are also sensitive to increases in underwater noise emissions. Slow moving whales are particularly vulnerable, but small cetaceans are also known to be affected. Considering that the Arabian Sea Humpback Whale (ASHW) is likely to be present within the Project Area from time to time and that this species triggers the IFC PS6 Critical Habitat status under Criteria 1, plus other potential trigger species (e.g., Sperm Whale, Bryde's Whale, Blue Whale, three species of marine turtles, Whale Shark and other species listed in IUCN's Red List), these receptors are considered to be highly sensitive. The risk of collision with turtles is considered low: the abundance of turtles is assessed to be low, but turtles find it difficult to detect vessels until they are in very close proximity.

The cumulative impacts associated to vessels strikes and underwater noise are considered to be a medium priority. Proposed mitigation measures are given in Section 8.6.10.4, including the recommendation to implement a biodiversity management plan including a system for approaching vessels to report marine fauna sightings, training and awareness raising about identifying sensitive species, in collaboration with SIPC and other developments in the area. Such a management plan shall consider the cumulative impacts.

Social Conditions

Local Economy and Employment

With regards to employment, the development of the Port of Sohar has been a key strategy from the government to create more jobs for both the growing population in the Governorate of Al Batinah North and for Omanis relocating from other Governorates. In particular, one of the objectives driving the expansion of the Sohar Port South (SPS) is to create new, long term job opportunities. The Project, as well as the other planned future developments in SPS, will contribute positively to the existing local economy, as it will need to hire workers and procure goods and services from the local job market. It will also lead to an increase in direct and indirect employment opportunities (primarily unskilled), especially during the construction phase; and an increase to economic impacts from taxes and fees, procurement and worker spending in the local market. Considering the above, the positive cumulative impact on the local economy and employment is considered to be **of minor priority**. As such, no additional measures are proposed to manage cumulative effects.

The larger population and worker presence, both from the Project and other planned developments in the area, could increase the demand for goods and services. Although this has positive economic benefits for business owners, it may in turn increase local prices for goods and services such as accommodation, food and other retail goods, which could affect the ability of vulnerable groups in the local community to access or afford such goods and services. In response to this, however, there may be an increase in secondary businesses exploiting new local markets by bringing in larger quantities of goods at lower prices. As such, the cumulative impact on price inflation is considered to be of **medium priority**.

Unmet Expectations and Benefits

The expectations among local residents for employment opportunities are high given the scale of industrial development witnessed in the Sohar area, the number of qualified and experienced Omani members of the labour pool in the Sohar area, the relatively high unemployment rates at in this labour pool. Omani communities around the project site have high expectations that local citizens should be prioritised for recruitment over Omani nationals from other Governorates.

Expectations with respect to investment in social and community development, and the level stakeholder engagement are also considered high based on based on feedback obtained during the social engagement process. The community's perception concerning social investment programs has been driven and raised to some extent by the performance of other Port tenants including the CSR initiatives implemented by Al Jusoor, which have set strong precedent for social development in the area.

However, not all groups feel that they have benefited equally. There is a sentiment of dissatisfaction among fishermen in regard to the restriction/loss of fishing grounds since the Sohar Port was constructed and expanded. In addition, they have the perception that continuous activities, such as discharge of cooling water, and periodic activities, such as dredging, has contributed the decline in fish stocks in the area. Other concerns raised by stakeholders include the effects of air emissions resulting from the industrial activity in the area. The cumulative impact of the Sohar Port activities along with the industrial activities being carried out could lead to a negative perception of the Project and future developments at the Sohar Port, regardless of whether these impacts are indeed attributable to the project or not.

As proposed as mitigation measures in Section 8.7.5.4, the Project will implement a Stakeholder Engagement Plan (SEP) and a Community grievance mechanism to ensure that individuals who have concerns or complaints about the Project or who wish to report their expectations or concerns about the local economy and employment prospects can communicate directly with the Project. It will develop an Industrial Baseline Survey (IBS) as well as an In Country Value (ICV) and Local Content to further enhance the potential positive local employment impacts of the Project. In addition, a Social Investment Plan and Community Needs Assessment will be developed by the Project in consultation with local communities. Through the implementation of the proposed mitigation measures, the Project's contributions to unmet expectations and benefits, cumulative effects will be minimised to a reasonable degree. Nonetheless, considering the high expectations of the stakeholders with regards to employment, community investment and stakeholder engagement and perceived impacts of the existing industrial activities, the cumulative impact is considered to be **of major priority**, since action on the short term is required in order to prevent and/or mitigate negative impacts towards the Project and planned developments.

Community Health, Safety and Security (CHSS)

The increase in traffic on local roads mostly during the construction phase, increase in marine traffic, air emissions as a result of the Project and other potential developments throughout their lifetime as well as additional risks of unplanned events, will result in cumulative impacts on community health and safety. These increases may put additional pressure on the existing health infrastructure and pose additional risks to health and safety of public road users, fishermen and the community living in proximity to the site. Environmental health issues related to the industrial activity in the area, in particular air quality, were one of the main concerns raised during field survey baseline data collection.

The influx and the potential increase of communicable diseases such as TB and sexually transmitted infections, especially during the construction phase of the Project and other potential developments due to the large influx of workers will also potentially result in cumulative impacts on community health and safety. Additionally, the rate of transmission of communicable diseases may also increase, for example if disease vectors such as mosquitoes are allowed to breed on site. The profile of these diseases will be influenced by the existing health profile of communities within the area of influence and that of the workers. Moreover, the large influx of workers will also potentially increase the risks of spreading of pandemics such as COVID-19, as worker housing mainly consists of high-density labour camps, and rented housing facilities, where measures to avoid spreading disease through social distancing for example may be difficult to implement and control.

As proposed as mitigation measures in Section 8.7.3.4, a Traffic Management Plan and a Marine Traffic Management Plan are proposed to be developed as part of the Project and implemented in consultation with the competent authorities and other projects. Nonetheless, the cumulative impact on community health and safety is considered of **major priority**, since action on the short term is required in order to prevent and/or mitigate negative impacts associated with the community health, safety and security. The development of health and safety plans with the support of government are recommended.

Social Infrastructure and public services

The Project and other developments in the area will increase labour requirements over and above those of the Project. This will enhance skills transfer in the economy; however, the increased labour requirements could also draw public sector employees into the private sector creating pressure on Government institutions and the provision of essential services, infrastructure and utilities.

Large scale projects can lead to an increase in population of the area in which they occur. This is due to the influx of both the local workforce, Omanis, and other economic migrants entering the area with the intention of securing employment. As so, there will be a likely increase in pressure on social infrastructure and demand for services from jobseekers, who have settled in the vicinity of the project.

As more projects are developed and overlap, it is likely that in-migration into the area will further increase, placing additional pressure on the availability of accommodations and on social infrastructure and services such as: health (in particular public care facilities), education, waste and sanitation facilities as well as religious and recreation facilities. Considering the potential negative impacts of increased pressure on social infrastructure and service delivery, the cumulative impacts are considered of **major priority**. To mitigate the negative cumulative impacts, the development of an influx management plan by the Project in conjunction with other projects in the area and local government is recommended.

The cumulative impact of the simultaneous operation of the Project and other developments may also lead to a rise in the demand of water supply, power supply, fuel supply. Given the future developments planned, the water demand will rise significantly in the long term which may put pressure on the water supplier of Sohar Power and Desalination Plant and other suppliers in the region. Considering this and the water scarcity in Oman the cumulative effect on water supply is considered a **major priority**. The government is expected to address this issue to meet the water demand in the industrial zone. With regards to the fuel and power supply, it is expected that the power and fuel supplier capacity is sufficient to meet the industrial supply-demand as well as the local supply-demand.

8.10.2.4 Step 6: Cumulative Impact Management Framework

The effective management of cumulative impacts requires a stakeholder consultation and a collaboration of all parties that contribute to these cumulative impacts. In many cases, a minor impact of a Project can result in a significant cumulative impact on a VEC. Consequently, the effective management of negative cumulative impacts transcends the capacity of a single interested party and therefore a management on two fronts is recommended:

- Apply a hierarchical mitigation methodology of the environmental and social impacts management generated by different Projects on the VEC (ecological or human): Avoid, Minimize, Compensate, and offset.
- Develop a collaborative approach of all stakeholders to implement collective management measures, since cumulative impacts cannot be managed at a single Project level. The creation of a provincial/regional and SIP port level framework for the management of cumulative impacts is essential.
- The management of cumulative effects is the shared responsibility of various proponents and actors. The proponent of a Project can take actions to minimize the contribution of its individual effects to cumulative effects. If individual actions are not sufficient to mitigate cumulative impacts, collaborative efforts are required (IFC, 2013).
- Ideally, cumulative impact management should be led by government entities that have direct influence on proponents, in order to identify the contributions of each actor and establish the mechanism to handle the cumulative effects. International best practice establishes that individual proponents should mitigate the effects generated by their Project and, at a minimum, support and influence cumulative effects management strategies (IFC, 2013).
- According to the evaluation, the VECs with negative cumulative impacts are vessel strikes and underwater noise on marine ecology (in particular during the operation phase), unmet expectations and benefits (Project’s lifecycle), pressure on social infrastructure and service delivery (Project’s lifecycle), pressure on water supply (Project’s lifecycle) and community health, safety and security (Project’s lifecycle).

8.10.3 Transboundary Impacts

The transboundary impacts of the Project are those that extend or occur across the national boundary (impacts that affect countries other than the country in which the Project will be constructed or operated).

Economy

During the construction phase, the Project will entail the purchase of equipment and other goods and services, generating business for suppliers. The mobilisation activities will consist of heavy equipment transportation, mainly through existing transportation routes, while raw materials will be sourced locally, where possible. Pipeline components, packages and main containers will be imported by sea to Sohar Port and then transferred to the relevant site locations via trucks. While part of the equipment will be from other countries, it is expected that the contracts will be mostly provided by specialist suppliers from the region or from Oman. The economic benefits will therefore primarily occur at the regional and national levels, and so, no significant transboundary impact on the economy is considered internationally.

The use of LNG as a ship fuel is innovative and comes at a time when the future of ship propulsion is shifting from fossil fuels to fuel systems with lower carbon content, and green finance is becoming more available to ease this transition. LNG is therefore considered a step on the transitional path to decarbonising maritime logistics, and therefore the introduction of LNG bunkering at Sohar Port will give it a competitive advantage with respect to attracting new trade away from other regional ports, both with respect to bunkering services but also potentially with respect to container traffic. Sohar Port currently competes with the Port of Fujairah in the United Arab Emirates, which is expanding its cargo handling capacity.

9 FRAMEWORK ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Introduction

9.1.1 Purpose

This chapter outlines the framework for environmental and social management of the LNG Bunkering project. The environmental and social management plan (ESMP) will form part of the Project's HSE Plan and will be developed as a separate standalone document to this ESIA before Project start-up.

The specific objectives of the Framework ESMP are to:

- Document the more general aspects of MARSA LNG LLC Oman approach to environmental and social management,
- Describe how the project's environmental and social impacts will be minimised and mitigated and positive impacts enhanced during project planning and implementation,
- Detail the programme that will monitor and report the project's effects and its compliance with regulatory and corporate requirements,
- Provide a framework for the development of detailed implementation plans by contractor(s) as summarized below

HSE Management plans & procedures	Comments
Traffic Management Plan, Road safety procedure	
Pollution Prevention and Control plan, spill prevention procedure	Following topics to be included ■ GHG management and monitoring plan ■ Noise control within working areas, neighbouring population, and sensitive receptors ■ Vehicles and Equipment Maintenance Program
Waste Management plan & handling procedure	
Hazardous Material Management Plan	
Emergency Response Plan	
Water Management Plan	
Biodiversity Management Plan	Following topics to be included (e.g., for jetty topside construction activities) ■ Alien Invasive Species Management ■ Ballast Water Management, if applicable
Sediment Control and Storm Water Management Plan	
Stakeholder Engagement Plan /Program	
Local Content Plan, Purchasing strategy	
Community Health and Safety Management Plan	
Community Grievance Mechanism	
Occupational Health and Safety (OHS) Plan	
Social Investment Plan and Community Needs Assessment	
Workers Management Plan	Following topics to be included ■ Worker Grievance Mechanism / Procedure

9.1.2 Scope

The scope of this document comprises the activities being undertaken during all phases of the LNG Bunkering project (construction and commissioning, operation and decommissioning), and demonstrates how design-based risk assessment and ESIA activities are being considered and implemented.

The requirements and commitments set out in this document are directly applicable to all Project personnel, including MARSA LNG LLC employees (full-time, part-time, temporary and seconded staff etc.). The EPC and other contractors and suppliers are required to implement management systems complying with the minimum standards set out by the Project Framework ESMP, as communicated in this document.

The ESMP is intended to address all aspects of “sustainability”, as addressed in the IFC Performance Standards. As such, it encompasses consideration of environment, social, occupational health and safety, and labour and working conditions. For the sake of simplicity, the acronym E&S is used throughout this document, but this acronym should be interpreted as including environmental aspects as well as social performance aspects (i.e. community relations, community health safety and security, labour and working conditions).

This ESMP is focused on the project components only, acknowledging that the risks that may arise from its Associated Facilities are considered and discussed in a separate ESIA and its associated ESMP.

9.1.3 Project Standards

The Project Standards governing the ESMP are included in Section 2 and Annex A of the ESIA, and include:

- All relevant regulatory requirements including: national policy, legislation and regulations, local development plans, relevant international treaties and agreements to which Oman is signatory;
- All Project-specific permits or directions from regulatory authorities;
- MARSA LNG LLC’s corporate requirements;
- International Lender’s Environmental & Social Requirements (International Finance Corporation & Equator Principles).

9.1.4 Management of Change

Some gaps and uncertainties mainly in project design inevitably remain in terms of information regarding the proposed Project at the time of completing this report. Changes in the Project may also occur due to unanticipated situations and adaptive changes may occur during the course of the project life cycle.

MARSA LNG LLC will implement a clear and transparent management of change procedure, in order to identify these gaps and uncertainties and to take them into account when they arise. The objective of the procedure is to ensure that the impact of changes is identified and assessed prior to changes being implemented.

The management of change procedure will ensure that:

- Proposed changes have a sound technical, safety, environmental, and commercial justification;
- Changes are reviewed by competent personnel and the impact of changes is reflected in documentation, including operating procedures;
- Hazards resulting from changes that alter the conditions assessed in the ESIA have been identified and assessed and the impact(s) of changes do not adversely affect the management of health, safety or the environment;

- Changes are communicated to personnel who are provided with the necessary skills, via training, to effectively implement changes;
- The appropriate responsible person accepts the responsibility for the change, and
- The Environmental Authority (EA) is updated on any material changes to the project plan.

This framework document will be developed into a full ESMP. As information regarding the uncertainties becomes available, the Project ESMP be reviewed regularly and updated as required during all project phases, to:

- ensure the Management Programme remains fit-for-purpose, complete, appropriate and robust;
- ensure changes in understanding of baseline conditions, Project standards and required mitigation strategies are fully incorporated, as they are agreed – via maintenance of the consolidated table of E&S commitments (Section 9.4);
- make any required updates which may be needed; and
- align with the envisaged timing of the Monitoring Visits performed by the Lender's Independent Environmental and Social Consultants (IESC).

9.2 MARSA LNG LLC E&P HSE Management System

MARSA LNG LLC E&P has a health, safety and environment management system (HSE MS) in place that contributes to controlling the HSE risks of its activities. It encompasses the organisational structure; planning activities; responsibilities; and practices, processes, procedures and resources utilised in maintaining conformance with the project's HSE policy derived from TotalEnergies HSE charter (see Figure 9-1) and achieving continuous HSE performance improvement.

Safety health environment quality charter

In accordance with its Code of Conduct, TotalEnergies has adopted the following principles concerning safety, security, health, the environment, quality and societal commitment:

1. TotalEnergies holds safety, security, health, respect for the environment, customer satisfaction, listening to all stakeholders by way of an open dialogue, as paramount priorities.
2. TotalEnergies complies with all applicable laws and regulations wherever it conducts its business and supplements them with specific requirements and commitments when necessary.
3. TotalEnergies promotes, among its employees a shared culture which the core components are professionalism, the rigorous compliance and application of regulations, skills management, incident feedback and continuous learning. This approach relies on the vigilance and commitment of all.
4. Each and every team member, at all levels, must be aware of their role and personal responsibility in the practice of their duties. Individuals must demonstrate the strictest discipline in preventing accidents and deliberate damage; in protecting health, the environment and product and service quality whilst addressing stakeholder expectations. Rigor and exemplarity in these fields are important criteria in evaluating the performance of each member of personnel, in particular for those in positions of responsibility.
5. TotalEnergies favors the selection of industrial and business partners on the basis of their ability to apply policies similar to its own concerning safety, security, health, the environment, quality and societal measures.
6. TotalEnergies implements, for all of its operations, appropriate management policies regarding safety, security, health, the environment, quality, societal commitment and a periodic risk assessment of relevant policies and measures. Any development of a project or launch of a product is undertaken upon full lifecycle risk assessment.
7. Appropriate safety, health, environmental, quality and societal commitment management systems for each business undergo regular assessment involving measurement of performance setting milestones, formulating relevant action plans and instituting suitable control procedures.
8. TotalEnergies implements incident response plans and means of intervention designed to face different types of events it may encounter. Such measures are periodically updated and reviewed during exercises.
9. TotalEnergies is committed to managing its energy consumption, emissions in natural environments (water, air and soils), production of final waste, use of natural resources and impact on biodiversity. It develops new processes, products and customer services in order to enhance energy efficiency and reduce environmental footprint.
10. TotalEnergies adopts a constructive attitude towards safety, security, health, the environment and quality, based on transparency and an open dialogue with stakeholders and outside parties. Through its societal commitment, TotalEnergies is particularly keen on contributing to the sustainable development of neighboring communities, with a focus on human, economic and social issues. It conducts its operations in such a way as to responsibly ensure security, in compliance with the Voluntary Principles on Security and Human Rights (VPSHR).

Patrick Pouyanné
Chairman and Chief Executive Officer

TotalEnergies

September 2021

Figure 9-1 TotalEnergies Health, Safety and Environment Policy

The MARSA LNG LLC E&P HSE MS is composed of 10 Common Principles, transposed into 55 Expectations and further elaborated into HSE specific rules.

The Common Principles are as follows:

- Principle 01 – Management, Leadership, Communication and Engagement
- Principle 02 – Compliance with Laws, Regulations and Group Requirements
- Principle 03 – Risk Management
- Principle 04 – Operations, Reliability and Efficiency
- Principle 05 – Contractors and Suppliers
- Principle 06 – Competence and Training
- Principle 07 – Emergency Preparedness
- Principle 08 – Incident & Accident Management and Information Sharing
- Principle 09 – Monitoring, Audit and Inspection
- Principle 10 – Performance Improvement.

The Common Principles are organised in line with the plan–do–check–act improvement cycle as shown in Figure 9-2.

Figure 9-2 Organisation of the Common Principles in the plan–do–check–act improvement cycle

In general terms, MARSA LNG LLC's HSE MS comprises a set of components that includes the following:

- HSE policy
- HSE objectives
- planning of activities to attain the HSE goals
- identification of the risks involved in MARSA LNG LLC's activities
- the organisation within which the HSE responsibilities are clearly defined
- competent, trained personnel
- internal and external communication
- practices and processes formally defined in controlled documentation
- the emergency response system
- evaluation of HSE performances and regular review of those performances
- corrective action plans
- an internal control programme
- Periodic management reviews of the action plans.

The application of these components for the MARSA LNG LLC Oman Bunkering Project will be further detailed in the following sections.

9.3 Resources, Roles and Responsibilities

MARSA LNG LLC Oman is committed to provide resources essential to the implementation and control of the ESMP. Resources include the appropriate human resources and specialised skills. As a contractual requirement, contractors are required to provide sufficient resources to manage the HSE aspects of their work. This includes providing adequate resources to monitor compliance of their subcontractors.

MARSA LNG LLC Oman is the Project Operator and is ultimately responsible for the management and supervision of all project activities. MARSA LNG LLC Oman has an HSE department which has responsibility for both HSE and Social Performance with dedicated staff, competent on the basis of appropriate education (i.e. education that enables staff to fulfil their contractual job description), training and experience.

The MARSA LNG LLC HSE Guidelines and Protocols assign responsibilities to all personnel throughout the Company and requires contractors to manage HSE in line with the Guidelines and Protocols. Following is a summary of key responsibilities.

The **General Manager** has overall responsibility for HSE and is thus responsible for assuring that the ESMP is developed and implemented in line with MARSA LNG LLC requirements via the provision of adequate resources. He/she will be assisted by its HSE Manager

Managers are responsible for:

- Managing resources in an effective manner to achieve MARSA LNG LLC's HSE Guidelines and Protocols & strategic HSE objectives.
- Develop, implement, monitor and maintain functional processes and procedures to ensure best practice within own area of responsibility.

Supervisors are responsible for:

- Through their own actions and behaviour, and workplace presence, show visual leadership and commitment to the health and safety of employees, protection of the environment and the avoidance of loss.
- Ensure that safety, health and environmental considerations are taken into account when work tasks that come under their areas of responsibility, are being planned and carried out. This includes ensuring that all significant safety and environmental aspects are adequately managed in accordance with the HSE Risk Register, Standards and Operational Procedures of the Company.
- Follow-up implementation of measures within their areas of responsibility.

All **MARSA LNG LLC Oman personnel & contractors** are responsible for:

- The application of the Total Oman HSE MS.
- The quality of their own work, and the safety and impact of their actions. Individuals shall report incidents and are encouraged to propose improvements. An individual, who finds that the work cannot continue without danger to life or health, shall take the required action to stop the work.

The Total Oman HSE department is headquartered in Muscat, where staff overseeing commissioning and operations will be located. Staff will also be located in Sohar to facilitate HSE and social performance oversight of site activities as well as to allow direct interface and access for stakeholders. These functions will manage the successful implementation of the Project ESMP and the continuation of the stakeholder engagement process.

Supervision of contractor activities will be conducted by the relevant MARSA LNG LLC Oman technical team. This will be accomplished through management controls over strategic project aspects and interaction with contractor staff where project activities take place. The MARSA LNG LLC Oman technical team will ensure that their contractors comply with relevant legislation and standards as indicated in Section 9.1.3.

Individual responsibilities and accountabilities will be defined through position descriptions and conditions of employment contracts. Environmental and social responsibilities will also be written into the service agreements of MARSA LNG LLC Oman.

9.4 Commitments register

The impact assessment along with identifying potential impacts arising from the different project phases on environmental, social and health components, outlined mitigation and management measures to be upheld on the Project, and the monitoring/reporting recommendations to demonstrate effective mitigation for E&S aspects. A consolidated summary of all required mitigation, management and enhancement measures proposed in this ESIA is provided in Table 9-1, Table 9-2, Table 9-3 and Table 9-4.

During negotiation of the EPC contract, a number of the commitments set out in in Table 9-1, Table 9-2 Table 9-3 and Table 9-4 will be cascaded to the EPC, who will lead day-to-day operations within the site fence, and associated EHS performance and delivery of related Project commitments. This will be done by including these in all EPC contracts as an appendix with signed duty to comply.

Table 9-1, Table 9-2, Table 9-3 and Table 9-4 will continue to evolve and develop, with further periodic reviews and updates, as the Project progresses, to take into account and record any additional commitments made by the Project, or measures which have been closed out and implemented.

9.4.1 Construction phase

Table 9-1 summarises potential impacts and related mitigation measures identified for the construction phase of the Project, the type of commitment and the associated management plan.

Table 9-1 Construction Phase - Mitigation measures

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Physical and Biological environment			
Air Quality			
AQ1 - Reduced ambient air quality caused by vehicles and machinery involved in construction activities	General mitigation measures: ■ Air emission specifications in compliance with best practice and legal requirements should be considered during all equipment selection and procurement; ■ Use of available fuels on the Omani market with minimum sulphur content; ■ Regular maintenance (as per manufacturers recommendations) of vehicles, machinery, and equipment in order to minimise the generation of air pollutants; ■ Atmospheric emissions from all transport vehicles used will be reduced by optimizing the number of journeys as far as possible; ■ It will be ensured that vehicles and machines will be turned off when they are not being used; ■ Implementation of a grievance mechanism in the event of complaints related to Air quality (i.e. dust generation etc.). Specific to this phase: ■ Limit construction during extreme weather conditions (e.g. high wind and dust storms) that can intensify dust generated from construction activity; ■ Construction activities associated with high dust (and other air emissions) generation (e.g. grading and excavation) must be avoided as far as possible at night, when it is difficult to visibly assess air emissions. If construction activities are unavoidable during these periods, sufficient lighting and/or monitoring must	■ Reduction ■ Management ■ Monitoring	■ Traffic Management Plan ■ Pollution Prevention and Control Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	be implemented to ensure air emissions are not elevated above normal visible working conditions; ■ Avoid or reduce (as far as practicable) Project vehicle traffic near communities and ensure vehicles follow journey management plans with designated routes; ■ Suitable management and maintenance of raw materials' storage areas to minimize clouds of particles; ■ Tarpaulin coverings on trucks during the transport of crumbly building materials or excavated earth or backfill; ■ Speed restrictions for vehicles travelling on non-asphalted roads; ■ Utilise grizzlies, railings or grates at the site exit points to dislodge the excess dirt and mud on vehicle wheels and under carriages; and ■ Utilise dust suppression techniques (e.g. spraying) on unpaved access roads in order to minimise dust generation.		
Noise			
N1 – Noise emissions from construction activities	■ Select available equipment and vehicles that optimise noise reduction; ■ Switch off equipment when not in use; ■ Limit (as far as practicable) the operation of non-routine high noise generating equipment during the holidays and night time; ■ Locate stationary equipment (i.e. generators) as far as practicable from nearby receptors; ■ Implement a Traffic Management Plan to minimise as far as practicable the induced traffic noise generated by the transit of heavy vehicles, in particular through the reduction of vehicles' speed when crossing inhabited areas and the provision of employee awareness training, if needed;	■ Reduction ■ Management	■ Traffic Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ An appropriate Vehicles and Equipment Maintenance Programme will be developed and implemented throughout the construction phase. ■ Noise will be monitored during the construction phase (including in sensitive receptors such as Majis village); monitoring will provide an extended profile of ambient noise at the project boundary and at receptors.		
Soil			
S1 - Soil degradation and contamination during construction works	General mitigation method: ■ Through the implementation of the Waste Management Plan, appropriate storage, transportation, and disposal of non-hazardous and hazardous waste generated during all phases; and ■ Excavation of contaminated soil, and immediate storage and appropriate disposal as hazardous waste. ■ Immediately notify the operations team/ control room of any leaks and spills as per the Emergency Response Plan. Specific to this phase: ■ Prior to the commencement of construction, a zero soil survey to SIPC standards (Version 1.2, March 6, 2014) will be conducted with the purpose to determine the soil quality of the reclaimed land (collecting and analysing metals and trace elements, TPH, aromatics, and PAH) and to have reference composition prior to a tenant's development of the site. ■ Regular maintenance of all heavy machinery and vehicles to avoid leak spills as part of a Vehicles and Equipment Maintenance Programme. ■ Through the implementation of the OSCP, provision secondary containment (i.e. drip trays and spill kits) heavy machinery and vehicles on site.	■ Avoidance ■ Management	■ Waste Management Plan ■ Oil Spill Contingency Plan (OSCP)
Landscape and Visual			

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
LF1– Reduced landscape aesthetic from material laydown area and dust generation during construction	General mitigation method: ▪ Appropriate storage and disposal of non-hazardous and hazardous waste. Specific to this phase: - Installation of fencing and barriers during construction to minimize visual impacts to nearby receptors; - Organized (neat and tidy) storage of all construction material and chemicals in laydown areas; and - Regular dust suppression.	▪ Avoidance ▪ Management ▪ Reduction	▪ Waste Management Plan ▪ Hazardous Material Management Plan ▪ Pollution prevention and control management plan
Groundwater			
GW1 – Groundwater degradation and diversion from excavation and spillage of hazardous material during construction.	▪ In order to limit potential groundwater exposure and diversion, pipeline and transmission line excavation should be done in sections. The length of the exposed trench segments will be established (during the risk assessment) before opening the trenches. Trenches will be filled-in before the next section is started. ▪ On the other hand, only in case it is strictly necessary for the potential burial of the condensate pipeline (~10 m long), after the corresponding geotechnical studies at the site, the section may be dewatered. Dewatering fluids will be handled and, if necessary, treated before discharge. Monitoring of the quality of groundwater abstracted during dewatering will be carried out.	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Hazardous Material Management Plan
Surface water			
SW1 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during construction.	General mitigation method: ▪ Through the implementation of the Waste Management Plan, appropriate storage, transportation, and disposal of non-hazardous and hazardous waste generated during all phases. ▪ Immediate excavation of contaminated soil and storage as hazardous waste.	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Hazardous Material Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Immediately notify the operations team/ control room of any leaks and spills as per the Emergency Response Plan. Specific to this phase: ■ Regular maintenance (as per manufacturers recommendations) of all heavy machinery and vehicles to avoid leak and spills as part of a Vehicles and Equipment Maintenance Programme. ■ Through the implementation of the OSCP, providing secondary containment (i.e. drip trays and spill kits) heavy machinery, hazardous and chemical storage areas. ■ Ensure appropriate clearance and disposal of hazardous waste and chemicals in storage areas. Any spills to be reported and mitigated as per the Emergency Response Plan.		■ Vehicles and Equipment Maintenance Programme. ■ Emergency Response Plan ■ Oil Spill Contingency Plan
Terrestrial Ecology and Habitats			
THE1- Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material during construction.	General mitigation method: ■ Appropriate storage and disposal of non-hazardous (including food) and hazardous waste generated during all phases (e.g. closed bins and frequent disposal). ■ Installation of fencing and barriers during all phases to ensure terrestrial wildlife in the project vicinity are kept out of the operational areas of the site. Specific to this phase: ■ Organized storage of all construction material and barrels in the laydown area. ■ Through the implementation of the Waste Management Plan, appropriate storage and containment of construction material and hazardous material in the laydown area. ■ Dust suppression to minimize dust generation.	■ Avoidance ■ Management	■ Waste Management Plan ■ Biodiversity Management Plan ■ Pollution Prevention Control and Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Refer to Noise mitigation measures.		
Seawater and Sediment Quality (SQ)			
SQ1 – Degradation of marine environment quality from construction and commissioning activities and materials	General mitigation method: ■ Where feasible, storm water from loading jetty topside and surfaces should be collected and disposed of appropriately in an onsite wastewater treatment system. ■ A Waste Management Plan and Pollution Prevention and Control Plan will be implemented, aimed at maintaining correct storage, treatment and disposal of operational facility discharges (Abate at Source/Site). ■ Litter, spills, and leaks will be cleaned up immediately. ■ MARSA LNG LLC shall engage with SIPC regarding the release of contaminants to the marine environment associated to the jetty construction activities. While jetty construction is outside the scope of this ESIA, it is recommended that the corrosion protection system used on the loading jetty (to be designed and installed by SIPC) should limit the release of contaminants to the marine environment (e.g. to less harmful materials such as aluminium or zinc should be used). Noting that while the jetty substructure is an associated facility of the project because MARSA LNG LLC will have its exclusive use, the maintenance of the jetty structure is not within the direct control of MARSA LNG LLC. MARSA LNG LLC shall exercise a duty of care to ensure that these structures are appropriately managed for any environmental risks arising, particularly in relation to marine contamination potential. ■ Develop a Sediment Control and Storm Water Management Plan for the construction and operational phase that addresses scenarios arising from expected events (i.e. with 25 year return period) and extreme events (with longer return periods) for exposed surfaces within the battery limit. If management and maintenance of common utility corridors carrying infrastructure for MARSA LNG	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan ■ Sediment Control and Storm Water Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	LLC's exclusive use, such as the condensate pipeline, buried electrical power cables, etc., are not within the direct control of MARSA LNG LLC, then MARSA LNG LLC shall exercise a duty of care to ensure that they are appropriately managed for any risks arising from these associated facilities. The duty of care shall include periodic visual inspection of unprotected surfaces, including after storm events, and, if necessary, monitoring of sediment volumes and quality. Similarly, MARSA LNG LLC should be diligent about ensuring that SIPC maintain storm drains to be kept reasonably free from sediment build up and vegetation growth. MARSA LNG LLC should develop a schedule of periodic storm water drain inspections and should take ownership of maintaining a clean road surface, should any traffic to the facility cause a spill or introduce dirt or contamination of the road surface. ■ Maintaining seawater quality is essential to minimise risk to marine ecology (which provides a potential pathway for contaminants to enter the human food chain via seafood) and commercial seawater users such as MISC and their tenants. Routine monitoring of ambient seawater and sediment quality will be conducted within the project area during construction and operational phase through specific environmental monitoring plans aimed at the offshore section of the Project. ■ MARSA LNG LLC shall engage with SIPC and request that SIPC periodically (annual) monitors sediment quality around areas where marine operations will take place to confirm sediment quality (during the jetty construction, for MARSA LNG LLC operations. This item is the responsibility of SIPC since it falls with the definition of handing over a site for development that is fit for purpose.		
Marine Ecology and Habitats			
ME&H1 – Degradation of marine habitat quality and ecosystem function from construction activities	■ Follow mitigation measures set out in for minimising/managing impacts to seawater quality and sediment quality. ■ Maintain correct storage, treatment and disposal of operational facility and vessel waste water streams and discharges, including storm water systems (Abate at	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	Source/Site), through specific management plans such as a Pollution Prevention and Control Plan and a Waste Management Plan.		■ Sediment Control and Storm Water Management Plan ■ Water Management Plan
Protected Species / Critical Habitat			
PS/CH1 – Impacts to protected species and critical habitat from underwater noise and ship strikes	■ Same applicable general mitigation measures as those proposed for marine environment and habitats.	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan ■ Sediment Control and Storm Water Management Plan ■ Water Management Plan ■ Biodiversity Management plan
Socioeconomic and Health Environment			
Livelihood and Local Economy			
EE1 - Temporary direct and indirect employment opportunities	The following enhancement measures will be implemented: ■ An Industrial Baseline Survey (IBS) will be developed, including the following: - Local capacity and skills assessment including (but not limited to) the Wilayat of Sohar and Liwa;	■ Management ■ Monitoring	■ Stakeholder Engagement Plan ■ Local Content Plan or In-Country Value (ICV)

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- Demand and supply-side analysis to identify which of the goods and services required for the Project could actually be sourced locally and in Oman; - Analysis on workforce capacity and capability and Local procurement opportunities ■ The IBS will also take into account findings from the Regulatory Study conducted for this Project in February 2018 which looks at Local Content and In-Country Value (ICV) requirements as well as any local content requirements enforced following 2018. ■ Local Content Plan will be developed to inform the Project's in-country value (ICV) planning, specifically, with respect to the employment potential for multiple positions and the local provisioning potential through local suppliers from the area, concretely; ■ As part of the tendering process, MARSA LNG LLC's contractors will be required to develop a purchasing strategy that stipulates how national and local purchase of goods will be optimised. The purchasing strategy will be required to adhere to all MARSA LNG LLC HSE policies and procedures. Agreed measures will be monitored and reported on. Motivation for the foreign import of materials and goods will be documented to illustrate why local alternatives where not used; ■ MARSA LNG LLC shall implement a phased capacity building programme (sector by sector) that will enable local companies to achieve qualifications and potentially certification to the relevant standards and requirements well in advance of the tendering process; ■ MARSA LNG LLC shall engage with local government, industry and other organisations to determine opportunities for targeted training; ■ Any selected potential suppliers will have to meet health, safety and quality standards;		■ Community Grievance Mechanism

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Following selection of primary contractors, the Project will carry out training of contractors on the Project HSE and socioeconomic and health policies prior to the start of construction; ■ The Project will work with local authorities and employment organisations to ensure that all positions are advertised in a manner that is accessible to the communities in the Social AoI. Unskilled workforce will be sources locally, to the extent possible (i.e. from Sohar and Liwa Wilayat); ■ The Project will ensure that the recruitment process is fair and transparent, public and open to all regardless of ethnicity, religion or gender; ■ The Project will agree an Employment Strategy with Primary Contractors that will include the expected level of local input for unskilled labour. Contractors will be required to attempt to source all unskilled labour from within Oman, and with best efforts to recruit unskilled labour as well as skilled labour to the extent possible from the communities of the Social AoI. Agreed measures will be monitored and reported on. ■ To facilitate access to employment opportunities for local candidates (within the wilayats of Liwa and Sohar) with appropriate skill sets, a database of people looking for work will be maintained and will identify the candidates' place of origin. ■ The Stakeholder Engagement Plan developed for the Project will be regularly updated and will be implemented to outline how the Project will ensure regular, open and transparent communication with all stakeholders, concretely: - To provide clear information on the number and limited timescales of employment opportunities. - To ensure information on the employment and the procurement strategies is disclosed at all settlements within the Social AoI.		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- To plan an engagement with stakeholders through early, inclusive dialogue to build a shared understanding of the potential positive and negative impacts of workers influx, and the associated risks and opportunities. - Continuing to engage local people in the employment opportunities and work with suppliers to enable capacity building, procurement, employment and contracting opportunities in the communities, as part of maximizing the positive benefits. - The Community Grievance Management Procedure described in the Stakeholder Engagement Plan will be implemented to ensure that stakeholders who have concerns or complaints about the Project or wish to report their potential expectations or concerns related to local economy and employment can communicate directly with the Project.		
EE2 - Temporary economic impacts from taxes and fees, procurement and worker spending	■ Same applicable enhancement measures as for EE1.	■ Management ■ Monitoring	■ Stakeholder Engagement Plan ■ Local Content Plan ■ Community Grievance Mechanism
Workers Management			
WM1 – Workers' Rights	The following mitigation or preventive measures will be implemented: ■ The Project will develop an Occupational Health and Safety (OHS) Plan as part of a Health and Safety Management System. The OHS Plan will comply with the requirements of the Ministerial Decision No. 286/2008. The Health and Safety Management System will be enforced throughout the Project and will be applicable to all Project personnel (including direct hire employees, advisors and consultants, contractors and sub-contractor personnel). It will include aspects	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ Workers Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	such as regular training and monitoring, as well as monitoring, inspection and audit. The following measures will be included: - MARSA LNG LLC will assess the potential for injury or risk of accident and will take into account prevailing environmental conditions at the site location, including the potential for extreme natural hazards such as earthquakes or hurricanes. All employees have the duty to stop any works if adequate systems to control risks are not in place. - MARSA LNG LLC will verify the results of the risk assessments with respect to potential hazards, aspects and impacts, and whether the necessary control measures are implemented. - Employees should not be under the influence of intoxicants, which could adversely affect the ability of that Employee to perform the work or adversely affect the health and safety of other Employees, other persons or the environment. - Surveillance programs for health status shall be established and implemented. In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, a health and safety committee will be established. Its duties will be training, monitoring as well as safety checks and audits. - Health and safety induction/training including fire safety training, emergency response procedures and LNG hazards (chemical, cold surfaces) will be provided to all employees (MARSA LNG LLC, contractors and subcontractors) exposed to these hazards. - As part of the contractor and supplier selection process MARSA LNG LLC will take into consideration the suppliers' performance with regard to worker health and safety as outlined in Omani law and policies, and international standards.		■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan ■ Human Resource Policies

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, the Project will provide regular medical check-ups and centralized medical assistance for all workers (MARSA LNG LLC, contractors and subcontractors). - Contractor contracts will establish the right for Omani Government monitoring and auditing of all contractors and subcontractors and the consequences for the contractor if they are found to be breaching national legal requirements, international standards, MARSA LNG LLC's policies or clauses in the contract. Contractor contracts will specify that the same standards will be met by their sub-contractors and suppliers. - Workers and sub-contractors will be provided with the means to ensure compliance such as information, instruction and training, work equipment and personal protective equipment (PPE). Training includes identification of potential hazards to workers, particularly those that may be life-threatening, as well as training in preventative and protective measures, including modification, substitution, or elimination of hazardous conditions or substances. - In accordance with MARSA LNG LLC's minimum requirements and the outcomes of the contract-specific risk assessment, appointed contractors are required to provide appropriate welfare facilities, first aid facilities and health assistance and ensure that trained personnel are present on site. Such provisions will be established at worksites prior to the start of any mobilization of the workforce. Any appointed contractors will establish their own Emergency Response Plan and communicate key information to the Project workforce prior to work commencing on any site. - A formal Permit to Work (PTW) system will be developed for the facilities. The PTW will ensure that all potentially hazardous work is carried out safely and ensures effective authorization of designated work, effective communication of the work to be carried out, including hazards involved, and safe isolation procedures to be followed before commencing work. A lockout/tagout procedure		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	for equipment will be implemented to ensure that all equipment is isolated from energy sources prior to maintenance or removal. ■ A Workers Management Plan will be developed (including workers' accommodation) considering the following elements: - No employee or job applicant will be discriminated against on the basis of their gender, marital status, nationality, age, religion or sexual orientation; - All workers will, as part of their induction, receive training on worker rights in line with Omani legislation and Company Standards to ensure that positive benefits around understanding labour rights are enhanced; - All workers (including those of contractors and subcontractors) will be able to join unions of their choice and have the right to collective bargaining; - All workers (including those of contractors and subcontractors) will have contracts which clearly state the terms and conditions of their employment and their legal rights; - Contracts will be verbally explained to all workers, in a language they understand where this is necessary to ensure that workers understand their rights; - Contracts must be in place prior to workers leaving their home location stipulating working hours, pay, and other terms of employment; - Contractor contracts will establish the right for MARSA LNG LLC monitoring and auditing of all contractors and subcontractors and the consequences for the contractor if they are found to be breaching national legal requirements, international standards, MARSA LNG LLC's policies or clauses in the contract. Contractor contracts will specify that the same standards will be met by their sub-contractors and suppliers; - MARSA LNG LLC and Contractors' will implement a program of socioeconomic compliance monitoring to inform internal auditing and monitoring process. As such, KPIs will be developed around worker rights, discrimination		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	and management, workforce grievance mechanism and monitoring of outcomes. As part of the contractor and supplier selection process, MARSA LNG LLC will take into consideration performance with regard to worker management, worker rights, health and safety as outlined in Omani law and ILO international standards; - As part of the contractor and supplier selection process MARSA LNG LLC will take into consideration performance with regard to worker management and rights as outlined in Omani law, international standards and MARSA LNG LLC's policies; - MARSA LNG LLC will oversee if suppliers comply with all applicable child labour laws and only employ workers who meet the applicable minimum legal age requirement in accordance with international standards; - MARSA LNG LLC will review and monitor the outcomes of community engagement, media coverage and its workforce and community grievance mechanism for additional indications of labour-related issues that may be arising; - MARSA LNG LLC will develop a Human Resources Policy which will outline worker rights to be included in all contracts including restrictions on working hours in line with Omani and international law, compensation including consideration of overtime, holidays etc. MARSA LNG LLC will require its contractors and subcontractors to put in place policies in line with national legislation and international regulations; and - A Labour Rights Assessment to inform the development of the Workers Management Plan will be developed considering the sensitivities of expatriate workers in Oman to better understand labour welfare and associated social risks. ■ A Worker Grievance Mechanism (WGM) will be developed: - MARSA LNG LLC will put in place and will require all contractors and sub-contractors to put in place a worker grievance mechanism that will be accessible to all workers, whether permanent or temporary, directly or indirectly employed.		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- The Grievance Mechanism should be: ▪ Legitimate: should be a clear, transparent and equitable process that is designed and implemented in accordance with the effectiveness principles, and which should encourage trust. ▪ Accessible: the procedures for using a WGM should be kept as simple as possible, avoiding unnecessary administrative stages. All workers should be informed about the grievance mechanism at the time they are hired. ▪ Predictable: Management should provide a clear and known procedure for using the WGM, together with an indicative time frame for each stage. ▪ Equitable: Workers and management should have reasonable access to sources of information, advice and expertise necessary to engage in a grievance process on fair and informed terms. Where there are language barriers, it may be necessary to provide written materials in different languages and to engage interpreters. ▪ Transparent: Every complaint should be treated seriously, and dealt with consistently and in an impartial, confidential and transparent manner. This builds the credibility of the mechanism among workers and ensures that it will be used. ▪ Rights-compatible: Outcomes and remedies should be in line with internationally-recognized human rights legislation, Total Standards and national law. ▪ Based on engagement and dialogue with stakeholders: Engaging with workers on the design and performance of a grievance mechanism can help to confirm that it meets their needs, that they will use it in practice, and that there is a shared interest in its success.		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- The MARSA LNG LLC worker grievance mechanism shall be open to the contractor and subcontractor workforce in the event that their grievance is not adequately resolved by their direct employer. MARSA LNG LLC will then have the authority to act to resolve this grievance. ■ The Project Stakeholder Engagement Plan will be regularly updated and will, including continuous engagement throughout the Project lifecycle with the Omani Trade Union and other key stakeholders including worker representatives.		
WM2- Child Labour in the supply chain	■ Same applicable measures as for WM1.	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan
WM3- Forced Labour in the supply chain	■ Same applicable measures as for WM1.	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan
Community Health, Safety and Safety			
CHSS1 – Safety Risks due to Increased Marine Traffic and vessel collisions	■ MARSA LNG LLC shall engage with SIPC regarding the development of a Marine Traffic Management Plan, including: - Process of notification to mariners of the presence of operations. - Standard vessel navigation and communication equipment such as radar, ship-to-ship radio, etc. will be utilised. - Monitoring of marine vessel traffic in the area with SIPC support - Consultation on an ongoing basis with fishermen and fishermen organisations (cooperatives) particularly regarding marine activities and any safety requirements with respect to exclusion zones. - A fishermen representative will act as a liaison between the Project and the fishermen venturing the area in order to facilitate and improve the communication and cooperation between the parties. - All Project vessels will have Health, Safety and Environmental management systems in place in accordance with international regulations (MARPOL). - Coordination meetings between MARSA LNG LLC and SIPC will be carried out regularly in regard to marine traffic advises and enforcement of exclusion and restricted areas - Consultation on an ongoing basis with fishermen particularly regarding their safe passage along the coast and formal and informal fishing practices in the area	■ Avoidance ■ Management ■ Monitoring	■ Marine Traffic Management Plan ■ Stakeholder Engagement Plan ■ Grievance Mechanism

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- Patrolling for enforcement of exclusion zone will continue to be led by the ROP in collaboration with the SIPC and the port authorities. - The Project should ensure that the parties engaged in maintaining the exclusion zones/avoidance areas have received adequate training on appropriate code of conduct and rules of engagement in accordance with the UN Voluntary Principles on Security and Human Rights. - A selection of appropriate marine equipment and implementation of high levels of vessel maintenance, captain awareness and training. - Hook-up to the GMA VTMIS (Vessel Traffic Management Information System) for access to real-time data on the presence of vessels in the vicinity of the exclusion zones. - Marine contractors shall submit suitable HSE plans including a security management plan and marine safety risk assessment including qualifications of marine vessel captains and crew, training conducted, and compliance auditing provisions. - The Project will establish a Grievance Mechanism to follow-up and close out any issues reported by stakeholders in regard to disturbance to fishing and right of passage - A Marine Traffic Study will be developed as part of the Marine Traffic Plan to undertake a detailed assessment of navigation routes for local fishermen further away from the coast and offshore by assessing the potential for interaction with marine traffic in the area and information on quantity and frequency of fishermen boats, including: ▪ Assessment of the navigation routes for local fishermen and the frequency of the use of the safety passage; ▪ Identification of potential additional impacts from increased restrictions to passage due to the construction of the Project jetty;		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	▪ Monitoring of marine vessel traffic in the area with the SIPC support ▪ Identification of the main sea users, including artisanal fishermen and commercial fishing entities. ■ A participatory community needs assessment will be developed, with a focus on AoI settlements and taking into account fishing communities, to inform the Project's community investment strategy. ■ Same applicable additional measures as for CHSS3		
CHSS2 - Impacts on Environmental Health - Air Quality degradation	■ Same applicable measures as for AQ1	■ Same as for AQ1	■ Same as for AQ1
CHSS3- Increased transmission of communicable diseases	■ A Workers Management Plan will be developed, including: - The implementation of a Workforce Code of Conduct and measures for living and working conditions which will contribute to reduce the risks of diseases transmissions into the community and a worker grievance mechanism. The Code of Conduct shall expressly prohibit sexual interactions of any kind with underage persons. - The Contractor will regularly monitor interactions between the community and workers both in public spaces in the communities and in private spaces, where vulnerable people have the greatest potential for abuse, especially children and young women. - Workforce (including subcontractors) will be provided with health awareness training, including a significant briefing of hygiene practices (such as hand washing), implementation of educational outreach to increase awareness of major communicable disease and how to protect against infection and about transmission routes and the symptoms of the communicable diseases of concerns (including STDs). - Conduct pre-employment screening protocols for all employees including contractors and subcontractors which will include testing for TB and other	■ Same as for CHSS1.	■ Workers Management Plan ■ Community Health and Safety Management Plan ■ Traffic Management Plan ■ Stakeholder Engagement Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	diseases appropriate to the individual's country of origin (e.g. hepatitis, acute respiratory diseases) and vaccinations. - Workers will be provided with primary health care and basic first aid at worksites. Additionally, MARSA LNG LLC will define designated project medical professionals in selected medical clinics in the AoI. - Regular medical check-ups and centralized medical treatment for all workers of the Project (MARSA LNG LLC, contractors and subcontractors) will be provided - MARSA LNG LLC and its contractors and subcontractors will as part of the induction process provide consistent training and education to all workers to ensure awareness of transmission routes and methods of prevention of STDs and other diseases of concern such as TB as well as early symptoms of such diseases. - MARSA LNG LLC, contractors and sub-contractors will provide cultural sensitivity training to remind workers they need to be sensitive of local women, norms and customs. ■ A Community Health and Safety Management Plan (CHSMP) will be developed, including the following health issues: - MARSA LNG LLC will undertake a health facility assessment of medical infrastructure within the Sohar area as part of the Health and Safety Management System to determine if facilities have sufficient resources and equipment to deal with emergencies. Agreements will be entered into with suitable hospitals to provide health care in emergency situations. These agreements will include provision of additional equipment or training for staff if required by MARSA LNG LLC. Project-dedicated international medical providers to complement the services of the local medical facilities that could be utilized by the Project and/or training of local medical personnel.		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- In line with the World Bank Environmental, Health and Safety Guidelines for Liquefied Natural Gas Facilities, MARSA LNG LLC will develop Emergency Response Plans (ERPs) taking into account access to health care, major incidences, multiple casualty events and pandemics. Ship traffic, including at loading and unloading jetties, associated with LNG facilities should be considered, with respect to local marine traffic patterns and activities. These should be developed in consultation with national emergency providers and local health care facilities and will cover all contractors and subcontractors as well as consideration of the local community. - MARSA LNG LLC will monitor the emergence of major pandemics through WHO alerts. When the WHO Pandemic Alert Scale reaches Level 4 MARSA LNG LLC will implement the relevant ERPs. ■ The Traffic Management Plan (see Section 8.7.4.4) will also include: - Any trucking companies employed to work on the Project will have policies around health screening of their workers in line with Project requirements; - MARSA LNG LLC Contractors & Subcontractors will ensure that all truck drivers who will work on site receive the training on worker code of conduct and disease awareness training; and - At site perimeter, MARSA LNG LLC EPC Contractor will review routes and journey plans for the truckers, including likely stopping points or rest stops. MARSA LNG LLC will provide details of the grievance mechanism at these locations; ■ A Stakeholder Engagement will be developed and regularly updated to, to include the following commitments: - MARSA LNG LLC will undertake a programme of stakeholder engagement and consultation through the Local Stakeholder Committee to educate local communities of the risks of trespassing onto sites, the meaning of signs and the dangers of playing on or near equipment or entering fenced areas. This will		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	include presenting in every primary and secondary school in communities. Records of the meeting and attendees should be kept; - MARSA LNG LLC will undertake stakeholder engagement with potentially affected communities and other stakeholders on a range of issues including changes to the visual environment, noise and socioeconomic concerns; - MARSA LNG LLC will implement the community grievance mechanism to address stakeholder concerns related to the Project in a timely manner.		
CHSS4- Increased pressure on health care	■ Same applicable measures as for CHSS3.	■ Same as for CHSS1.	■ Same as for CHSS1 and CHSS3.
Traffic and Transport			
TT1- Disruption to existing road users on local roads during construction	A Traffic Management Plan will be developed in consultation with the competent authorities, traffic police and municipalities, and implemented throughout construction. The following measures will be adopted in the Project Traffic Management Plan to mitigate the impacts of construction traffic: ■ The Contractor will liaise with the appropriate regulatory authorities to gain approval to use, and regularly inspect, the road infrastructure; ■ Precautions will be taken by the Contractor to avoid damage to the public roads used by vehicles or other items of equipment. Where tracked equipment will be used, timber mats, tyres or steel plates will be laid as necessary. Any road damage will be repaired to an equal or better standard in a timely manner; ■ Advance warning will be given of any proposed road diversions and closures (if required);	■ Avoidance ■ Management ■ Monitoring	■ Traffic Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ If road closures are required, diversions will be planned and communicated to the authorities (including emergency services and public transport providers) and affected communities in advance (via the pre-construction community meeting) and will be properly sign-posted. ■ Crossing for pedestrians and animals will be provided to avoid the need for a diversion; ■ If the Contractor requires additional routes, a specific proposal will be submitted to the relevant authorities for consideration and approval; ■ Liaison with the police and other authorities will occur prior to the movement of any abnormal loads; ■ Speed limits will be established and enforced over all construction traffic routes; ■ The Contractor will comply with all statutory vehicle limits (width, height, loading, gross weight) and any other statutory requirement; ■ Drivers of Project vehicles will be trained/briefed about safe driving with respect to other drivers, pedestrians, cyclists and livestock); ■ Clear signs, flagmen and signals will be set up where necessary. Where temporary traffic signals are required, the details and locations of the signs shall be discussed with the relevant authorities. The signs will be fixed safely and securely to ensure that they do not become detached or dislocated, and will be visible and comprehensible by all. The Contractor will also carry out maintenance checks to clean and re-secure signs if necessary; ■ Signing will be provided (where it is not already present) to advise drivers of distances to the next passing location (to minimise inappropriate overtaking of slow moving vehicles); ■ Project vehicles to be identifiable to the Project (e.g. an easy to read/see sign or symbol on vehicles which shows that they are connected to the Project);		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ All Project vehicles will be regularly maintained and drivers will be trained in driving methods designed to avoid unnecessary emissions and which are considerate to the local communities (e.g. switching engines off when waiting to enter site or stationary on site, avoiding engine stress and reducing vehicle speed in and near communities); ■ Assignment of heavy vehicle construction traffic to suitable routes to and from the working area; ■ Temporary road closures (during works for new or altered roads) will be scheduled, as far as is practical, during times which will minimise disruption to road users (and planned in conjunction with the authority); ■ Advanced warning of the proposed temporary road closures and diversions will be provided to the public (e.g. suitable signage and information in the press); ■ Address how the Contractor can reduce the exposure of vehicle drivers, their passengers and other road users from the hazards of road-related accidents; ■ Education on traffic safety will be provided by the Community Liaison Officers (CLOs) to communities not normally subjected to high traffic loads; ■ Provide briefings and awareness raising for workers on work camps with respect to safe and considerate driving; ■ The Contractor shall be expected to develop and implement management systems and procedures that will provide the highest level of control over hazards to personnel associated with vehicle transportation, both on- and off-road; ■ The Contractor's procedures shall specifically cover arrangements for the following important aspects: - The source of and number of qualified drivers required. - Training and approval requirements for drivers.		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- Hours of driving and rest periods. - Security arrangements for drivers, vehicles and loads. - Arrangements for driver communication with control points and vehicle equipment. - Language/communication issues. - The source of suitable vehicles (e.g. quality and specification). - The number of vehicles required. - The programme for preventative vehicle maintenance. - Vehicle routes, route planning and alternative routes. - Overall vehicle movements. - Procedures for the emergency recovery of vehicles. - An appraisal of the socioeconomic impacts of vehicles in the local community. - Procedures for spot checks and audits of the transport system and for reporting problems. ■ Control and supervision of the arrival and departure of construction traffic at site entrance; ■ Agreement of routes to be used by vehicles delivering 'abnormal loads' (i.e. slow moving, very high or wide loads) and their timing in conjunction with the authority (and the Police); provision of advance warning of the routes and times of abnormal load deliveries; ■ Restrictions on construction traffic movements during periods of heavy traffic on the road network if necessary;		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ The contractor will be required to undertake regular inspections to ensure adherence to the Traffic Management Plan; ■ Provision shall be given for the continuation of normal traffic during open-cut road crossings and all open cuts shall be covered at the end of each working day ■ If night-time work is required under an emergency operation, then warning lights will be used around the working site; ■ A method statement will be produced for each crossing, for approval by the appropriate authorities prior to commencing work; ■ Where roads used by children to reach schools are utilised by construction traffic, road safety education will be provided at schools. Vehicle traffic will be minimised during hours that children are travelling to and from school; ■ Appropriate supervision will be provided by the Contractor to control the flow of traffic when machinery needs to cross roads; ■ Traffic flows will be timed, wherever practicable, to avoid periods of heavy traffic flow along main roads. ■ Access and site roads will be maintained in good condition; and ■ Dedicated areas will be designated for end of day parking and routine maintenance / checks of the project vehicles. These areas will be away from public and private lands to avoid nuisance to public and complaints.		
Community Cohesion and Expectations			
CC1 – Disturbance from presence of workforce	■ Stakeholder Engagement Plan (SEP). Through different communication and engagement methods, stakeholders in the immediate vicinity of the construction works will be kept informed about the planned activities, timelines, potential impacts and changes to schedules, if any. Stakeholders should be made aware of whom to address and how to raise any concerns or grievances. This will include the following:	■ Reduction ■ Monitoring ■ Management	■ Stakeholder Engagement Plan ■ Social Investment Plan and Community Needs Assessment

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- Communication will be based on the principle of transparency and clarity, clearly explaining the selection process and criteria. This will imply transparent and clear communication in regard to the rules of equitable distribution amongst AoI communities and the establishment of priorities for Social investment. - Quarterly project update leaflets will be prepared and widely distributed from six month prior to construction to the end of the construction phase. These information releases will emphasise the limited nature of employment and the recruitment processes and the inclusive nature and progress of the Social Investment Plan. - The grievance mechanism will be adjusted to the Project construction phase with the relevant contractor and sub-contractor staff fully aware of their roles in third party grievance resolution process so that quick and effective response is provided to the concerns raised by local stakeholders; additional resources if necessary to resolve concerns within stipulated timescales. - The Project will communicate to affected stakeholders the progress on meeting the Project's environmental and socioeconomic commitments during the construction phase through, at a minimum the release of quarterly performance reports which will be posted on the Project website. - The Project will agree with government and other stakeholders the scope of third-party monitoring, which might involve local stakeholder representatives, in assessing whether social and environmental impact mitigation measures and other intended benefits are as effective as anticipated. The reports of the third-party monitoring will be made available to the public through MARSA LNG LLC website. - Meeting minimum standards for stakeholder engagement and social performance will be used as one of the selection criteria for the main contractors. - Communities will be engaged in the preparation of the social and environmental investment activities to be taken forward in the vicinity of their		■ Workers Management Plan ■ Grievance Mechanism

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	communities. They will then be kept informed on the progress of such activities and opportunities for their involvement will be maximised. - Fair distribution of potential project-related opportunities among AoI communities to minimize tension and competition between locals. Ongoing dialogue between the Project, through the Community Liaison Officer (CLO) and local communities to assist in information sharing with regard to employment practices and the use of non-local staff. Local communities to be provided information on the number of non-locals to be brought to the area, their housing arrangements and the measures that the Project is putting in place to ensure that all workers abide by local customary practices. Information will also be shared on the number of local unskilled and semi-skilled as well as skilled positions available to local residents, along with the recruitment methods used to identify potential candidates. - Relevant Project information in particular those related to environmental and socioeconomic impacts, employment and project benefits will be disclosed at the local level in a manner that is accessible, understandable and culturally appropriate for those affected. This will be facilitated by the MARSA LNG LLC and EPC Contractor Community Liaison Officers (CLOs) employed for the duration of construction and operation activities. The CLOs will proactively and regularly engage with local stakeholders prior to commencement of construction activities, providing updates and answering their queries. The CLOs will be present on the ground during the whole construction process and available to the potentially affected communities. The aim of this is to ensure that all working practices are transparent and any issues between local residents and non-local workers are communicated and dealt with early on. ■ For workers housed in private residences, a monitoring plan regarding worker-family interactions will be established. The monitoring plan will be described in the Worker Management Plan. ■ The EPC Contractor will be required to develop a Workers Management Plan, which will set out the conditions of employment and expected behavioural		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	practices of all employees during the construction phase (no offence to cultural norms; no marginal activities such as gambling or substance abuse; no petty crime and fighting, no sexual abuse…). ■ Grievance Mechanism. A Project grievance mechanism, as described in the Project SEP, will be developed and implemented, and information about this mechanism will be shared amongst local communities. The EPC Contractor will also be responsible for managing a grievance mechanism that allows communities and employees to raise complaints. This will be a key monitoring and reporting requirement of the Project. The grievance mechanism will be implemented prior to commencement of the construction phase, with all relevant staff fully cognizant of their roles in the grievance resolution process so that quick and effective response is provided to the concerns raised by local stakeholders. ■ A Social Investment Plan and Community Needs Assessment will be developed by the Project in consultation with local communities, with active engagement required to determine the location and nature of investments. Relevant stakeholders will be kept informed on the progress of investment activities and opportunities.		
CC2 - Influx of Non-Local Workers and Opportunity Seekers	■ Same applicable measures as for CC1.	■ Same as for CC1.	■ Same as for CC1.
CC3- Unmet expectations of benefits	■ Same applicable measures as for CC1.	■ Same as for CC1.	■ Same as for CC1.
Ecosystem Services			
Reduction in access to ecosystem services. Disturbance to fauna and flora from air emissions, noise and light and depletion of natural resources (e.g. water, wood) for operation activities resulting in a reduction or loss of associated ecosystem services.	■ The mitigation measures required to minimise impacts on ecosystem services are in line with each of the impacts identified for the Physical, Biological and Social environmental components identified in the Project baseline. ■ Mitigation measures included for the operation phase on its different components will also apply for the ecosystem services.	■ See mitigation measures for Physical, Biological and Social environmental components	■ All management plans can be applied to Ecosystem Services ■ Same as above. ■ Same as above.

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Potential pollution of soils and water with the associated loss on ecosystem services provided.	■ Mitigation measures set forth during the construction phases will be implemented also during operation. ■ Same as above. ■ Same as above.	■ Same as above. ■ Same as above.	

9.4.2 Operation phase

Table 9-2 summarises potential impacts and related mitigation measures identified for the operation phase of the Project.

For a number of impacts, the commitment in this framework ESMP is that the mitigation measures defined for the construction phase will continue to be implemented during the operation phase.

However, it should be noted that when the operations ESMP is developed, MARSA LNG LLC will update and adapt the mitigation measures as needed, and with the assurance that they will be at least as stringent and protective of the environment as the ones defined in the framework ESMP. This will be done based on result of monitoring and additional, refined design information (including updated noise modelling for example). According to current plan, the operations ESMP will be developed at least 6 months prior to the commencement of project operations.

Table 9-2 Operation Phase - Mitigation measures

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Physical and Biological environment			
Air Quality			
AQ2 - Reduced ambient air quality caused by LNG start-up activity	■ Flaring will only occur during the start-up, shut down and in emergency situations as all the previous operating flaring cases have been eliminated at the design stage. The initial start-up flaring will be carried out with a lower amount of hydrocarbon being flared thanks to the use of nitrogen; Flare stack design as per best practise will be ensured, so to facilitate the dispersion of emitted pollutants during the start-up, shut down and in emergency situations; ■ Implementation of a grievance mechanism in the event of complaints related to Air quality.	■ Design; ■ Reduction ■ Management.	■ Pollution Prevention and Control Plan
AQ3 - Reduced ambient air quality caused by LNG normal operations	■ Same applicable general mitigation measures than the ones proposed for construction and commissioning phase; ■ LNG vessel loading activities to comply with international standards (e.g. International Maritime Organization codes, Society for International Gas Tanker and Terminal Operators guidelines) and codes relating to hull requirements, cargo containment, pressure/temperature controls, and fire protection; ■ Ensure design specifications for combustion sources are in compliance with local legislations and international standards; ■ Ensure feasible cost-effective options for reducing air emissions (e.g. wet suppression, exhaust filters etc.) are implemented; ■ Boil off gas generated on site will be recovered and recycled in the LNG liquefaction process;	■ Design; ■ Reduction ■ Management.	■ Pollution Prevention and Control Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Leak detection and repair programmes will be implemented and the selection of valves, flanges, fittings, seals, and packings must consider safety and suitability requirements, as well as their capacity to reduce gas leaks and fugitive emissions (as per IFC best practices).		
AQ4 - Reduced ambient air quality caused by vessel movement and loading	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase ■ LNG vessel design, construction, and operational phases will comply with international standards (e.g. International Maritime Organization codes, Society for International Gas Tanker and Terminal Operators guidelines) and codes relating to hull requirements, cargo containment, pressure/temperature controls, and fire protection.	■ Design; ■ Reduction ■ Management.	■ Pollution Prevention and Control Plan
Noise			
N2 – Noise emissions from LNG operations	■ Selection of equipment according to the best technologies available in terms of noise reduction; ■ An appropriate Vehicles and Equipment Maintenance Programme will be developed and implemented throughout the operation phase. ■ Noise will be monitored during the operation phase (including in sensitive receptors such as Majis village); monitoring will provide an extended profile of ambient noise at the project boundary and at receptors.	■ Reduction ■ Management	■ Traffic Management Plan ■ Vehicles and Equipment Maintenance Programme
Soil			
S2 - Soil contamination during operation and maintenance phase	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase ■ Regular maintenance of operational equipment in LNG train as part of a Vehicles and Equipment Maintenance Programme.	■ Avoidance ■ Management	■ Waste Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Providing secondary containment for operational equipment (i.e. pumps, compressors, emergency generators etc.) and for diesel storage, chemical storage and hazardous waste storage. ■ Appropriate waste and wastewater management to avoid spillage and minimise soil pollution. ■ Development of an Emergency Response Plan which should be actioned in the event of leaks and spills.		
Surface water			
SW2 – Contamination of storm water runoff from waste and hazardous material spills.	■ Through the implementation of the Waste Management Plan, appropriate storage, transportation, and disposal of non-hazardous and hazardous waste generated during all phases. ■ Immediate excavation of contaminated soil and storage as hazardous waste. ■ Immediately notifying HSE personnel of any leaks and spills as per the Emergency Response Plan. ■ Regular maintenance of operational equipment in LNG train. ■ Providing secondary containment for operational equipment (i.e. pumps, compressors), diesel storage, hazardous waste storage and chemical storage areas. ■ Manage waste and wastewater adequately in order to avoid spillage and minimise soil pollution. ■ Ensure storm water is appropriately collected and channelled into the storm water drainage system. ■ Test and treat collected runoff (if necessary) to ensure compliance with national and international standards before discharge.	■ Avoidance ■ Management	■ Waste Management Plan ■ Hazardous Material Management Plan ■ Water Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Terrestrial Ecology and Habitats			
THE2 - Disruption to terrestrial ecology and habitat from waste, noise and air emissions, and flaring during operation.	■ Same applicable general mitigation measures than the ones proposed for commissioning and construction phase ■ Through the implementation of the Waste Management Plan, organized storage of hazardous material/substances and waste storage areas. ■ Ensure all transportation vehicles maintain allowed routes and abide by speed limits. ■ Regular maintenance of operational equipment in LNG train; ■ Providing secondary containment for the storages of hazardous liquids (lubricants, fuel for generators, etc.) required for the operation of plant equipment (i.e. pumps, compressors, standby generators etc.); ■ Immediately notify the operations team / control room of any leaks and spills as per Emergency Response Plan. ■ Minimise lighting levels, eliminating unnecessary lighting and to reduce nightglow and the extent of visibility of the LNG port; ■ Minimise duration that temporarily stored contaminated storm water is kept on site. ■ Installation of bird deterrent-reflectors should be considered near infrastructure that may attract or harm birds (e.g., flare and waste storage). ■ MARSA LNG LLC shall engage with SIPC for the establishment of a Biodiversity Management Plan including a bird monitoring program to assess the effect of flaring though engagement with SIPC and other industries carrying out flaring in the SIP area, and put in place appropriate mitigation measures.	■ Avoidance ■ Management	■ Waste Management Plan ■ Pollution Prevention Control and Plan ■ Traffic Management Plan ■ Biodiversity Management Plan ■ Emergency Response Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Seawater and Sediment Quality (SQ)			
SQ2 – Degradation of seawater and sediment quality as a result of vessel and jetty operations, and storm water runoff	■ Where feasible, storm water from loading jetty topside and surfaces should be collected and disposed of appropriately in an onsite wastewater treatment system. ■ A Waste Management Plan and Pollution Prevention and Control Plan will be implemented, aimed at maintaining correct storage, treatment and disposal of operational facility discharges (Abate at Source/Site). ■ Litter, spills, and leaks will be cleaned up immediately. ■ Maintaining seawater quality is essential to minimise risk to marine ecology (which provides a potential pathway for contaminants to enter the human food chain via seafood) and commercial seawater users such as MISC and their tenants. Routine monitoring of ambient seawater and sediment quality will be conducted during the operational phase through specific environmental monitoring plans aimed at the offshore section of the Project.	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan ■ Sediment Control and Storm Water Management Plan
Marine Ecology and Habitats			
ME&H2 – Degradation of marine habitat quality and ecosystem function from operation activities.	■ Follow mitigation measures set out in for minimising/managing impacts to seawater quality and sediment quality. ■ MARSA LNG LLC shall engage with SIPC regarding the maintenance of correct storage, treatment and disposal of operational facility and vessel waste water streams and discharges, including storm water systems (Abate at Source/Site), through specific management plans such as a Pollution Prevention and Control Plan and a Waste Management Plan.	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan ■ Sediment Control and Storm Water Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ MARSA LNG LLC shall engage with SIPC regarding general support on IFC shipping safety management strategies and develop pollution management plan to include relevant elements to MARSA LNG LLC such as: - Hazardous materials: ▪ Operational certification of the ship according to applicable requirements depending on the purpose and capacity of the vessel; ▪ Preparing and implementing spill prevention procedures for bunkering activities in port and at sea. For oil tankers taking on LNG as bunker fuel, follow the applicable requirements, and only permit double-hull design access to the loading jetty area as a spill prevention measure; ▪ Prohibit ship to ship transfer of cargo (lightering) and bunkering activities in accordance with specific safety regulations and guidance to minimize the risk of spills; ▪ Preparing and implementing spill prevention procedures for LNG carriers and oil tanker bunkering according to applicable standards and guidelines which specifically address advance communications and planning with the receiving terminal; ▪ Adequately securing hazardous materials and oil containers on deck; ▪ Maintain emergency plans to address accidental releases of LNG, oil or noxious liquid substances; ▪ Maintaining the necessary specific oil and noxious liquid substances spill prevention plans and procedures for operations in Special Areas (Annex I and II of MARPOL 73/78). - Establishment of a Biodiversity Management Plan that includes a Ballast Water Management Plan and a Management and Monitoring Plan for Alien Invasive Species.		■ Biodiversity Management Plan ■ Water Management Plan ■ Hazardous Materials Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	- Ballast water management plan must include but not be limited to: ▪ Inspect and maintain a written record of cargo and ballast operations (Oil Record Book as noted in Annex I of MARPOL. 73/78, and Ballast Record Book as required under the Ballast Water Convention) for vessels arriving for bunkering and for LNG carriers arriving for loading bulk cargo and/or bunkers; - The Ballast Water Management plan for vessels using the terminal must be audited to confirm compliance with the requirements of the Ballast Water Convention. Alien Invasive Species Management Plan must include but not be limited to: ▪ In coordination with SIPC, who owns this risk for general operation of Sohar Port, carry out a high-level (rapid) risk assessment of invasive species risk during operational period and act on any recommendations arising. ▪ If recommended by the risk assessment, carry out periodic (annual) and focused monitoring of fouling organisms on loading jetty legs and nearby revetment and armour units using rapid assessment techniques such as environmental DNA (eDNA) during the operational phase. ■ Marine Operations: MARSA LNG LLC shall engage with SIPC with regards to the environmental standards and procedures applied to the LNG terminal operations and to Sohar Port generally. As the project moves towards the operational phase a detailed review of the environmental standards currently being applied by Sohar Port terminal operations should be conducted to ensure they are consistent with MARSA LNG LLC company standards, MARSA LNG LLC's Company methods for evaluating HSE aspects of LNG terminal operations. Apart from safety aspects, the focus on environmental management should include: ■ Discharges to the marine environment		

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Pollution prevention and controls ■ Ballast water and hull fouling management ■ Management of wildlife collisions ■ Engage with SIPC for the establishment of “low power propulsion zones” in the Project area to minimize effects of underwater noise and disturbance of the seabed by propeller wash, in coordination with SIPC		
Protected Species / Critical Habitat			
PS/CH1 – Impacts to protected species and critical habitat from underwater noise and ship strike	■ MARSA LNG LLC shall engage with SIPC for the establishment of “low power propulsion zones” in the Project area to minimize effects of underwater noise and the risk of ship strikes. This is something that could be considered for implementation by SIPC port-wide. ■ MARSA LNG LLC shall engage with SIPC for the establishment of a Biodiversity Management plan that includes a Whale Mitigation Management Plan. The plan involves a system for approaching ships to report whale sightings, temporary and localised speed restriction zones (‘dynamic management zone’) on approach, training and awareness raising about identifying sensitive species and the issue of ship strikes.	■ Avoidance ■ Management ■ Monitoring	■ Biodiversity Management plan
PS/CH2 – Impacts to protected species and critical habitat from underwater noise and ship strikes	■ Same applicable general mitigation measures than the ones proposed for commissioning and construction phase.	■ Avoidance ■ Management ■ Monitoring	■ Water Management Plan ■ Waste Management Plan ■ Pollution Prevention and Control Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Sediment Control and Storm Water Management Plan ■ Biodiversity Management plan
Socioeconomic and Health Environment			
Livelihood and Local Economy			
EE3 - Long-term direct and indirect employment opportunities	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase. ■ Ensure that the recruitment process is fair and transparent, public and open to all regardless of ethnicity, religion or gender. ■ Disclose the employment and procurement strategies at all settlements within the Social AoI. ■ To facilitate access to employment opportunities for local candidates (within the wilayats of Liwa and Sohar) with appropriate skill sets, a database of people looking for work will be maintained and will identify the candidates' place of origin. ■ Implement the Community Grievance Management Procedure described in the Stakeholder Engagement Plan to ensure that stakeholders who have concerns or complaints about the Project or wish to report their potential expectations or concerns related to local economy and employment can communicate directly with the Project.	■ Management ■ Monitoring	■ Stakeholder Engagement Plan ■ Local Content Plan ■ Community Grievance Mechanism
EE4 - Long-term economic impacts from taxes and fees, procurement and worker spending	■ Continue to engage local people in the employment opportunities and work with suppliers to enable capacity building, procurement, employment and contracting opportunities in the communities, as part of maximizing the positive benefits	■ Management ■ Monitoring	■ Stakeholder Engagement Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	■ Disclose the employment and procurement strategies at all settlements within the Social AoI. ■ Implement a phased capacity building programme that will enable local companies to achieve qualifications and potentially certification to the relevant standards and requirements well in advance of the tendering process. ■ Implement the Community Grievance Management Procedure described in the Stakeholder Engagement Plan to ensure that stakeholders who have concerns or complaints about the Project or wish to report their potential expectations or concerns related to local economy and employment can communicate directly with the Project.		■ Local Content and Procurement Plan ■ Community Grievance Mechanism
Workers Management			
WM4 – Workers' Rights	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan
WM5- Child Labour in the supply chain	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management	■ Occupational Health and Safety (OHS) Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
		■ Monitoring	■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan
WM6- Forced Labour in the supply chain	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan
Community Health, Safety and Safety			
CHSS5 - Safety Risks due to Increased Marine Traffic and vessel collisions	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	■ Same as CHSS1 .	■ Same as CHSS1. .

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
CHSS6 - Impacts on Environmental Health - Air Quality degradation	■ Same applicable measures as for AQ 2,3,4 and 5	■ Same as for AQ 2,3,4 and 5. .	■ Same as for AQ 2,3,4 and 5. .
CHSS7- Increased transmission of communicable diseases	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Same as CHSS3.	■ Same as CHSS3. .
CHSS8- Increased pressure on health care	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Same as CHSS4	■ Same as CHSS4.
Traffic and Transport			
TT2- Disruption to existing road users on local roads during operations	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	■ Avoidance ■ Management ■ Monitoring	■ Traffic Management Plan
Community Cohesion and Expectations			
CC4 – Unmet expectations of benefits	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase The following stakeholder engagement measures will be implemented during operations: ■ Reduction and / or replacement of community liaison officers will be carefully managed during the transitioning of construction to operation in order to maintain the knowledge and relationships built between project representatives and local stakeholders until this point and ensure continuity. Retaining the same community liaison personnel or ensuring overlap between outgoing and incoming teams for successful knowledge transfer will be considered during this period.	■ Reduction ■ Monitoring ■ Management	■ Stakeholder Engagement Plan ■ Social Investment Plan and Community Needs Assessment ■ Workers Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	Stakeholders will be kept informed about changes that will impact them due to transfer to the operation phase. Commitments made to stakeholders relevant to the operation phase will be integrated into operation phase management systems and functions; ■ The Project will continue to engage with stakeholders through a combination of meetings, focus groups, surveys, suggestion boxes, etc. The plan for stakeholder engagement for the operation phase will be finalised six months prior to the transition to operations and shared with key stakeholders. The plan will also be posted on the Project website. ■ Stakeholder information will be reviewed on at least on annual basis to reflect changes in leadership, the emergence of new groups or shift in concerns or influences of existing ones; ■ The communications mechanisms and success of these will be reviewed annually for effectiveness and the stakeholder engagement plan will be revised to take into account the results of the review. ■ A publicly disclosed annual report will be prepared that will include meeting ESIA and other commitments, changes made to project design or operational procedures with potential impacts on certain stakeholder groups, any unforeseen changes, regular maintenance procedures, emergency response plans and safety and security requirements, and social and environmental investment activities and outcomes. The coverage of different issues will be proportionate to the extent of Project impacts and stakeholder interests. ■ The grievance mechanism will remain in place and regularly communicated to stakeholders. ■ The Project will involve affected stakeholders or third-party representatives in monitoring of the Project's socioeconomic and environmental performance for issues of great interest to the public.		■ Grievance Mechanism

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Ecosystem Services			
Reduction in access to ecosystem services.	▪ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	▪ See mitigation measures for Physical, Biological and Social environmental components	▪ All management plans can be applied to Ecosystem Services
Disturbance to fauna and flora from air emissions, noise and light and depletion of natural resources (e.g. water, wood) for operation activities resulting in a reduction or loss of associated ecosystem services.	▪ Same as above.	▪ Same as above.	▪ Same as above.
Potential pollution of soils and water with the associated loss on ecosystem services provided.	▪ Same as above.	▪ Same as above.	▪ Same as above.

9.4.3 Decommissioning phase

Table 9-3 summarises potential impacts and related mitigation measures identified for the operation phase of the Project. Potential impacts and related mitigation measures for the decommissioning phase of the Project will be similar to those expected for the construction phase.

Appropriate mitigation will be addressed by a decommissioning plan (see Section 9.5.17). The decommissioning plan will be revised one year before the scheduled decommissioning and will take into account the conditions of the project facilities, the national and international EHS regulatory framework and best industry practices at that point in time.

Table 9-3 Decommissioning Phase - Mitigation measures

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Physical and Biological environment			
Air Quality			
AQ5 – Reduced ambient air quality caused by vehicles and machinery involved in dismantling activities.	Same applicable general and specific mitigation measures than the ones proposed for the commissioning and construction phase	▪ Reduction ▪ Management	▪ Traffic Management Plan ▪ Pollution Prevention and Control Plan ▪ Decommissioning Plan
Noise			
N3 - Noise emissions from dismantling equipment	▪ The same mitigation measures considered for the construction phase will be implemented during the decommissioning phase.	▪ Reduction ▪ Management	▪ Traffic Management Plan ▪ Decommissioning Plan
Soil			
S3 - Soil degradation and contamination during decommissioning	▪ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase ▪ Regular maintenance of all heavy machinery and vehicles to avoid leak spills as part of a Vehicles and Equipment Maintenance Programme. ▪ Providing secondary containment (i.e. drip trays and spill kits) of heavy machinery and vehicles on site, fuel storage areas, hazardous waste and chemical storage areas;	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Vehicles and Equipment Maintenance Programme. ▪ Decommissioning Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
	▪ Manage waste and wastewater adequately to avoid spillage and minimise soil pollution; and ▪ Conducting a zero-soil survey (as per SIPC standards) at the end of the decommissioning phase to assess difference in potential contamination levels in the soil compared to the zero-soil survey carried out prior to the commencement of construction.		
Landscape and Visual			
LF3 – Reduced landscape aesthetic from material laydown area and dust generation during decommissioning.	▪ Same applicable general mitigation measures than the ones proposed for commissioning and construction phase.	▪ Avoidance ▪ Management ▪ Reduction	▪ Waste Management Plan ▪ Hazardous Material Management Plan ▪ Pollution Prevention and control management Plan ▪ Decommissioning Plan
Groundwater			
GW3 – Groundwater degradation and diversion from excavation and spillage of hazardous material during decommissioning.	▪ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Hazardous Material Management Plan ▪ Decommissioning Plan
Surface water			

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
SW3 – Disruption and contamination of storm water runoff from excavation and hazardous material spills during decommissioning	▪ Same applicable general mitigation measures than the ones proposed for commissioning and construction phase	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Hazardous Material Management Plan ▪ Decommissioning Plan
Terrestrial Ecology and Habitats			
THE3 - Disruption to terrestrial ecology and habitat from waste and spillage of hazardous material decommissioning	▪ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	▪ Avoidance ▪ Management	▪ Waste Management Plan ▪ Biodiversity Management Plan ▪ Pollution Prevention Control and Plan ▪ Decommissioning Plan
Seawater and Sediment Quality (SQ)			
SQ3 – Degradation of seawater quality due to vessel operations and storm water run off.	▪ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	▪ Avoidance ▪ Management ▪ Monitoring	▪ Waste Management Plan ▪ Pollution Prevention and Control Plan ▪ Sediment Control and Storm Water Management Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Decommissioning Plan
Marine Ecology and Habitats			
ME&H3 – Degradation of marine habitat quality and ecosystem function decommissioning activities	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Waste Management Plan ■ Pollution Prevention and Control Plan ■ Sediment Control and Storm Water Management Plan ■ Biodiversity Management Plan ■ Water Management Plan ■ Decommissioning Plan
Protected Species / Critical Habitat			
PS/CH3 – Impacts to protected species and critical habitat from underwater noise and ship strikes	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	■ Avoidance ■ Management ■ Monitoring	■ Water Management Plan ■ Waste Management Plan ■ Pollution Prevention and Control Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Sediment Control and Storm Water Management Plan ■ Biodiversity Management plan ■ Decommissioning Plan
Socioeconomic and Health Environment			
Livelihood and Local Economy			
EE5 - Temporary direct and indirect employment opportunities (primarily unskilled)	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Management ■ Monitoring	■ Stakeholder Engagement Plan ■ Local Content Plan ■ Community Grievance Mechanism ■ Decommissioning Plan
EE6 - Temporary economic impacts from taxes and fees, procurement and worker spending	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Management ■ Monitoring	■ Stakeholder Engagement Plan ■ Local Content Plan ■ Community Grievance Mechanism ■ Decommissioning Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Workers Management			
WM7 – Workers' Rights	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan ■ Decommissioning Plan
WM8- Child Labour in the supply chain	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Decommissioning Plan
WM9- Forced Labour in the supply chain	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Occupational Health and Safety (OHS) Plan ■ Emergency Response Plan ■ A Workers Management Plan ■ Worker Grievance Mechanism ■ Stakeholder Engagement Plan ■ Decommissioning Plan
Community Health, Safety and Safety			
CHSS9- Increased transmission of communicable diseases	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Avoidance ■ Management ■ Monitoring	■ Workers Management Plan ■ Community Health and Safety Management Plan ■ Traffic Management Plan ■ Stakeholder Engagement Plan

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
			■ Decommissioning Plan
CHSS10- Increased pressure on health care	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Same as above. .	■ Same as above. .
Traffic and Transport			
TT3-Disruption to existing road users on local roads during decommissioning	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase.	■ Avoidance ■ Management ■ Monitoring	■ Traffic Management Plan
Community Cohesion and Expectations			
CC5 – Unmet expectations of benefits	■ Same applicable general mitigation measures than the ones proposed for the commissioning and construction phase	■ Reduction ■ Monitoring ■ Management	■ Stakeholder Engagement Plan ■ Social Investment Plan and Community Needs Assessment ■ Worker Management Plan ■ Decommissioning Plan
Ecosystem Services			
Reduction in access to ecosystem services.	■ Same applicable general mitigation measures than the ones proposed for commissioning and construction phase.	■ See mitigation measures for	■ All management plans can be

Potential Impacts	Mitigations	Type of Commitments	Relevant Management Plan
Disturbance to fauna and flora from air emissions, noise and light and depletion of natural resources (e.g. water, wood) for operation activities resulting in a reduction or loss of associated ecosystem services.		Physical, Biological and Social environmental components	applied to Ecosystem Services
Potential pollution of soils and water with the associated loss on ecosystem services provided.			

9.4.4 Unplanned events

The following Table 9-4 summarises the mitigation measures related to unplanned events within the different phases of the Project.

It must be noted that due to the current stage of design of the LNG plant, there are 3 Front End Engineering Designs (FEED) being developed with their associated Quantitative Risk Assessments (QRAs). Once a final design is selected and detailed design commences, the mitigation measures required to address risks identified for unplanned events will be revised and updated according to the final studies.

Table 9-4 Unplanned events - Mitigation measures

Potential Unplanned Event	Mitigation of Unplanned Events	Type of Commitments	Relevant Management Plan
Terrestrial Operations			
Uncontrolled loss of containment at the plant leading to: ▪ Jet, pool and flash fires scenarios across the plant; ▪ Overpressure effects in case of an explosion; ▪ Cryogenic burns; ▪ Toxic dispersion.	▪ Mitigation measures for unplanned events, necessary to guarantee ALARP for the terrestrial operations, are linked in the QRAs to address risk reduction measures on human risks. These reduction measures are being investigated and assessed by MARSA LNG LLC through Risk Reduction workshops and iterations of the QRAs as the project design phases advances and will be included in the project design and management in due course. The aim of these is to reduce the residual risks, similarly to the routine impacts, to an acceptable level, or if not possible to ensure ALARP level.	▪ Management ▪ Monitoring ▪ Avoidance ▪ Reduction	▪ Emergency Response Plan
Marine Operations			
Vessel Collision, causing a spill	▪ Mitigation measures for unplanned events, necessary to guarantee ALARP for the terrestrial operations, are linked in the QRAs to address risk reduction measures on human risks. These reduction measures are being investigated and assessed by MARSA LNG LLC through Risk Reduction workshops and iterations of the QRAs as the project design phases advances and will be included in the project design and management in due course. The aim of these is to reduce the residual risks, similarly to the routine impacts, to an acceptable level, or if not possible to ensure ALARP level.	▪ Management ▪ Monitoring ▪ Avoidance ▪ Reduction	▪ Emergency Response Plan ▪ Oil Spill Contingency Plan

9.4.5 Cumulative impacts

Main mitigation measures related to cumulative impacts are those adopted by the Project to address the significant impacts identified in order to reduce to the extent possible the remaining residual impacts.

However, solutions to address properly the cumulative effect derived from the development of several projects in a given area are beyond any individual project developer. In this context, the approach adopted by MARSA LNG LLC to mitigate the cumulative impacts will be to use their best efforts to engage other developers, governments, and other stakeholders by acknowledging the cumulative impacts and risks and suggesting coherent management strategies to mitigate them.

In this context, MARSA LNG LLC will promote the following actions so as to ensure proper coordination with relevant authorities and other developments to minimize cumulative impacts:

- Apply a hierarchical mitigation methodology of the environmental and social impacts management generated by different Projects on the VEC (ecological or human): Avoid, Minimize, Compensate, and offset.
- Develop a collaborative approach of all stakeholders to implement collective management measures, since cumulative impacts cannot be managed at a single Project level. The creation of a provincial/regional and SIP port level framework for the management of cumulative impacts is essential.
- The management of cumulative effects is the shared responsibility of various proponents and actors. The proponent of a Project can take actions to minimize the contribution of its individual effects to cumulative effects. If individual actions are not sufficient to mitigate cumulative impacts, collaborative efforts are required (IFC, 2013).
- Ideally, cumulative impact management should be led by government entities that have direct influence on proponents, in order to identify the contributions of each actor and establish the mechanism to handle the cumulative effects. International best practice establishes that individual proponents should mitigate the effects generated by their Project and, at a minimum, support and influence cumulative effects management strategies (IFC, 2013).
- According to the evaluation, the VECs with negative cumulative impacts are vessel strikes and underwater noise on marine ecology (in particular during the operation phase), unmet expectations and benefits (Project's lifecycle), pressure on social infrastructure and service delivery (Project's lifecycle), pressure on water supply (Project's lifecycle) and community health, safety and security (Project's lifecycle).

9.5 Specific management plans and procedures

The Management Plans proposed below are intended to be 'live' documents and therefore shall be regularly updated as the project evolves and movement requirements are known therefore in more detail. The following plans will be established through engagement with SIPC and other tenants where applicable such as the Biodiversity Management Plan, the Ballast Water Management Plan, the Alien Invasive Species Management Plan and the Marine Traffic Management Plan as these refer to marine traffic, vessel movements and operations inside the port area. In addition, the development of plans such as health and safety plans and the influx management plan be carried out with the support of government to mitigate cumulative impacts.

9.5.1 Traffic Management Plan

A Traffic Management Plan (TMP) will be developed to set out the necessary requirements to be implemented by the project to mitigate potential risks and/or avoid negative factors to the environment, workers, and adjacent community with regards to the traffic during the phases of construction and operations. It shall be developed in compliance with the requirements of Omani regulations and relevant international standards (IFC).

The TMP shall describe expected project related traffic at each phase, including: 1) sources of traffic, 2) types of vehicles, 3) abnormal loads, 4) and offsite traffic and routes. It shall also provide a brief understanding of the conditions of existing road infrastructure potentially impacted by the project.

The TMP should include management measures to control traffic safety at the site and along routes used by the project. It will also detail who will be responsible for implementing these controls. The implementation of these measures shall be verified on an on-going basis.

In particular, the TMP shall define management measures for the following aspects:

- Traffic management/journey management,
- Vehicle breakdown response,
- Vehicle and equipment maintenance and inspections programme,
- Hours of operation,
- Traffic accident contingency,
- Environmental management (noise, pollution, debris),
- Social and community management (including communications).

The TMP shall also define the following key aspects associated to the TMP:

- Roles and responsibilities for implementation of the TMP;
- Project driver training requirements with respect to road safety and environment;
- Speed limits and methods of enforcement;
- Means to inform the community of traffic risks;
- Vehicle equipment;
- Vehicle maintenance and refuelling locations;
- Inspection, auditing and reporting; and
- Driver competency.

Additionally, the TMP will consider the accumulated increase in traffic and road use derived from the potential development of nearby projects at the same period of time, enhancing the development of a common TMP for the different projects involved.

9.5.2 Water Management Plan

The overall objective of the Water Management Plan (Water MP) is to ensure an adequate management of water resource and minimize the risks associated with water resource selection and consumption for the Project activities. Water will be used and disposed of in a manner consistent with Omani legislation and where appropriate, international good practices. A contingency plan will be drafted in case the MISC or Sohar Power and Desalination Plant suffer disruption in their normal activities.

Objectives of this Water MP can be summarized as follows:

- Ensure compliance with local legislation/permitting regulations and industry best standards, developing necessary management practices;
- Describe methods for assessing and protecting water uses and resources that may be impacted by project activities or operations (e.g. drinking uses, ground water for agricultural irrigation, other users that are not beneficiaries to the project, etc.);

- Apply sustainable criteria to identify opportunities for water savings and define objectives and targets, which should be continuously revised and updated to prevent fluctuations in surface or groundwater levels;
- Identify appropriate activities and indicators to incorporate into the monitoring program to control the water used;
- Draft a contingency plan in case monitoring indicators identify supply problems of the local communities due to water shortages related to disruption of MISC or Sohar Power and Desalination Plant; and
- Define the responsible parties required to ensure the achievement of each objective and identify their required trainings in water management.

9.5.3 Pollution Prevention and Control Plan

The Pollution Prevention and Control Plan will be developed to cover all project phases and will be aligned with the Emergency Response Plan and the Oil Spill Contingency Plan. The plan will be produced following relevant Omani legal requirements and best practices and will include provisions for the training of all workers and procedures related to communications to stakeholders and community improvement opportunities like workers and public awareness plans regarding pollution prevention and environment protection.

Typically, a Pollution Prevention and Environmental Monitoring Plan covers the following elements:

- General measures to be followed on site during the construction phase. General measures will include housekeeping, good material handling practices and inspection procedures.
- Prevention of accidental spills through the application of a series of actions and measures to prevent leakages and spills and to enable effective response to unplanned releases of liquids, such as fuels, oils and chemicals.
- Product Specific Practices will be adopted for the following:
  - Petroleum products: vehicles and construction equipment will be monitored for leaks and receive regular preventive maintenance to reduce the potential for leakage. Petroleum products will be stored in tightly sealed containers that are clearly labelled;
  - Paints: containers will be tightly sealed and properly stored when not required for use. All excess paint materials will be properly disposed of according to manufacturer's instructions.
- Air Emission Management Plan: an air emissions management plan for project activities will be implemented, including the definition of the Project air pollutant emission sources and the management measures to be applied for the control, and if feasible, the reduction of emissions. The plan will include appropriate monitoring methods and frequencies to show compliance with national legislation.
- Noise Emission Management Plan: a noise emissions management plan for project activities will be implemented, including the definition of the Project noise emission sources and the management measures to be applied for the control, and if feasible, the reduction of noise emissions. The plan will include appropriate monitoring methods and frequencies to show compliance with national legislation.
- A GHG management and reporting plan will be implemented in order to track yearly energy consumption and GHG emissions of the LNG Plant. This plan will be developed in addition to the yearly GHG reporting that the Project will submit to EA. Project alternatives will be also considered, with regards to operational loads and direct sources of energy consumption which can possibly be managed to reduce GHGs. This includes considering the development of energy conservation measures in the company as well as energy efficiency measures. A consideration

will be given to putting in an energy management system such as ISO 50001 in order to optimizing both direct fuel consumption and electricity consumption in the plant.

- Isolation of Potentially Hazardous Materials: supply of drums will be available for use in the event of spills or if potentially hazardous materials are found during project construction. The contaminated material will be placed in the drums, sealed and placed in the storage area to await proper characterization and disposal. In the event that a larger amount of material needs to be isolated, it will be placed directly into a lined roll-off container from a licensed hazardous waste transporter. The roll-off container will be placed out of the flow of construction traffic and equipment, in a bermed area to contain and isolate possible leaks and rainwater.
- Product Substitution: a policy of using environmentally friendly products will be adopted. In particular, when feasible, non-chlorinated solvents, paints with low volatile organic compound content, and non lead-based paints will be used. Organic biocides will replace chlorine in cooling water systems, if feasible, and assessment will be developed to determine the availability of less harmful substances. A list of prohibited materials will be provided, these will be prohibited from purchase due to their extreme hazardous or toxic nature.

In addition, the Pollution Prevention and Control Plan will establish the management procedures (collection, storage, treatment and disposal) for those wastewater streams not addressed in the Waste Management Plan, including:

- Bilge water discharge: All Project vessels will be equipped with oil-water separation systems in accordance with MARPOL requirements.
- Deck run-off water: Any spills on deck will be contained and controlled using absorbing materials. This will be collected in dedicated drums to avoid contamination of deck run-off water before being discharged overboard.
- Sewage discharge: Project vessels will be equipped with a sewage treatment system according to IMO regulations. If a vessel does not have a sewage treatment system, it will have a suitable holding tank to collect and store waste water. These tanks will be taken ashore for its proper treatment and disposal by a licensed contractor.

The wastewater streams associated to vessel movements will be established through engagement with SIPC.

It also defines:

- auditing requirements
- reporting and follow up
- awareness initiatives
- roles and responsibilities.

9.5.4 Waste Management Plan

MARSA LNG LLC shall develop and implement a Waste Management Plan (WMP) which defines how wastes, including solid and liquid waste, will be reduced, re-used, collected, managed, recycled and disposed of in an appropriate manner and in accordance with national legislation and good international practice.

The WMP will provide the basis for all the waste management arrangements and act as a central point of reference for how wastes will be managed by the Project. The WMP will cover the following aspects:

- Purpose/Objectives – of the Plan
- Context – legal requirements and general principles

- Roles and Responsibilities – of different staff and contractors
- Waste Arising (Types and quantities of key waste streams and Waste classification – local/international) per defined period (e.g. month, year)
- Waste Minimisation
- Waste Storage and On-site Handling (including segregation of different waste types)
- Reuse and Recycling
- Waste Collection and Transfer
- Final Treatment and Disposal (taking into account the waste acceptance criteria provided by the final treatment and disposal facilities selected)
- Waste Tracking, Data Management and Reporting
- Communications/Community Liaison

9.5.5 Hazardous Materials Management Plan

The hazardous materials management plan should include measures to manage the risks associated with the production, handling, storage, and use of hazardous materials. Measures may include:

- Develop Standard Operating Procedures (SOPs) for the management of secondary containment structures, including integrity inspections and the removal of any accumulated fluid, such as rainfall, to ensure that the containment capacity.
- Provide secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids which is at least 110% of the largest container or 25% of the total volumes of fuel and fluids stored (whichever is greater).
- Undertake refuelling and other fluid transfer only in areas with impervious surfaces.
- Develop procedures for transfer and handing of fuels and chemicals and the response to spills including use of spill kits.
- Provide training on transfer and handing of fuels and chemicals and the response to spills for workers involved in the handing of fuels and chemicals.
- Provide any specific personal protective equipment (PPE) required to respond to an emergency and training on its use.
- Provide spill kits, portable spill containment and clean up equipment on site in areas where fuel and chemical handling takes place.
- Identify training requirements for personnel handling hazardous materials.

9.5.6 Biodiversity Management Plan

MARSA LNG LLC Oman shall develop and implement a biodiversity management plan to monitor, mitigate, and document fauna (i.e. migratory birds and cetaceans) interaction with Project infrastructure and activity. Migratory bird and cetacean specific strategies will be developed to avoid, minimise, and respond to interaction where possible, and will include the following objectives as a minimum. The Biodiversity Management Plan as well as the Ballast Water Management Plan, the Alien Invasive Species Management Plan will be established through engagement with SIPC and other tenants where applicable.

- To generate and maintain an awareness of the sensitivity of the terrestrial and marine habitat as well as wildlife in the vicinity of the port;
- To define institutional and employee responsibility for animal management and impact mitigation in the area;

- Encourage the participation of other community stakeholders in the plan including, the Environmental Society of Oman (ESO), maritime service industry, tourism sector and local fishing community;
- To provide concise procedures for:
  - Detection, reporting & recording of large migratory bird and cetacean sightings and incidents.
  - Avoidance of incidents through defined management and mitigation measures.
  - Response to animal interaction with Project infrastructure (e.g. bird flare strike) and activity (e.g. cetaceans ship strike, entanglement and stranding incidents).

As part of the Biodiversity Management Plan, the following plans will be established:

- Ballast Water Management Plan and a Management and Monitoring Plan for Alien Invasive Species.
  - Ballast water management plan: ballast tanks will be separated from any hydrocarbon storage areas on board the vessels and no potentially contaminated drain systems will be routed to the ballast tanks. De-ballasting shall be undertaken offshore in accordance with IMO guidelines and away from sensitive environmental areas to prevent introducing marine organisms from outside the Project location. This is also a requirement of the Sohar Port and needs to be determined and reported by vessels to the Port Coordination Centre (PCC) through vessel arrival notice.
  - Alien Invasive Species Management Plan: including a measure to develop high level risk assessment of invasive species risk introduction and associated definition mitigation, monitoring and management measures during the operation phase of the Project.
- Whale Mitigation Management Plan: including measures to report whale sightings, temporary and localised speed restriction zones (‘dynamic management zone’) on approach, training and awareness raising about identifying sensitive species and the issue of ship strikes.
- Bird monitoring programme: including measures to mitigate impacts on birds related to flaring, collisions, waste generation and management.

9.5.7 Marine Traffic Management Plan

A Marine Traffic Management Plan (Marine Traffic MP) will be developed to manage the vessel movements and ensure the safe passage of local fishing boats along the coast. The Marine Traffic MP will be developed taking into consideration the mitigation measures included in this ESIA and in compliance with Omani statutory requirements, best practices and in coordination of the Oman navy. The Marine Traffic MP will be established through engagement with SIPC.

The Marine Traffic MP should include the following elements:

- Consultation with local fishing communities on the Marine Traffic MP and fishermen will be provided with up-to-date information on marine logistics.
- Definition of speed restriction and exclusion areas.
- Coordinated monitoring of Project vessel movements.
- Marine safety awareness campaign, targeting fishing communities, to reduce the risks of marine traffic accidents for all types of fishing vessels.
- Procedure for a constructive outreach to the navy through consultation, as well as training on human rights.
- Community engagement and grievance mechanism to ensure that any concerns on Project Marine Traffic can be raised and managed promptly using a transparent process.

- A Marine Traffic Study will be developed as a database of local fishing vessels, including smaller craft to identify the fishing boats who regularly use the area.
- Minimise marine accidents though high levels of Project vessel maintenance, Project driver awareness, training and awareness raising amongst vulnerable water users.
- Marine contractors will submit suitable HSE plans which will include a marine safety risk assessment. This includes qualifications of marine vessel captains and crew, training conducted and compliance auditing.

9.5.8 Sediment and Storm Water Management

A sediment and storm water management plan will be developed and implemented to avoid and minimise soil erosion as well as the spread of contaminated material from stormwater runoff during construction.

The Plan will take into consideration the mitigation measures included in this ESIA and comply with Omani statutory requirements and best practices.

Where practicable, soil handling and transfer will follow accepted best practice such as that set out in BSI 3882 (2007) and BSI 6031 (2009). Stormwater management will be undertaken in accordance with national legislation and IFC General EHS guidelines for wastewater and ambient water quality (IFC, 2007: 28-29) where practicable.

9.5.9 Stakeholder Engagement plan

The Stakeholder Engagement Plan is intended to build and maintain positive relationships between the Project and relevant stakeholders. It establishes procedures for constructive engagement and continuous dialogue that are essential to good business practice and corporate citizenship, as well as Project risk management and performance improvement.

The SEP is presented in Appendix B and it includes:

- Description of national regulatory, internal company requirements and international standards
- Identification and assessment of the Project stakeholders
- Strategy and proposed engagement actions with stakeholder per Project phase
- Resources and responsibilities for implementing stakeholder engagement activities; and
- Monitoring and reporting of SEP activities.

9.5.10 Community Grievance Mechanism

The Community Grievance Mechanism describes the process, roles and responsibilities for registering, investigating, resolving and remedying local stakeholders' grievances received.

The Grievance Mechanism describes the different stages of the process that each grievance follows:

- Grievance reception
- Grievance acknowledgment
- Grievance assess and assign
- Grievance investigation
- Grievance resolution proposal
- Grievance follow up and close-out

Section 9 of the SEP describes the Community Grievance Mechanism (Appendix B).

9.5.11 Industrial Baseline Survey and Local Content Plan

The objective of the Industrial Baseline Survey and Local Content Plan is to ensure the management and control of activities aimed at maximizing workforce, goods and services on the project and developing capacity among the employees and the local suppliers but also the local communities and supply chain.

This Plan sets out opportunities, MARSA LNG LLC will use commercially reasonable efforts to require and encourage contractors, or other intermediaries procuring labour, goods and services, to apply comparable standards.

This Industrial Baseline Survey (IBS) will outline the rules and regulations as well as an analysis of the capacities available in Oman, in terms of goods, services and workforce. This study will help define guidelines for the local content plan. The IBS will also take into account findings from the Regulatory Study conducted for this Project in February 2018, which looks at Local Content and In-Country Value (ICV) requirements as well as any local content requirements enforced following 2018. The IBS is expected to be developed at least one year before the start of the construction phase and will be used to inform the Project's in-country value planning, specifically, with respect to the employment potential for multiple positions and the local provisioning potential through local suppliers from the area.

Overall objectives of this Plan can be summarized as follows:

- Demonstration of the use of local labour from within the developer's project team and the company;
- Establishment of recruitment and training opportunities within the contractor's company;
- Provide opportunities for local residents to access employment opportunities created during the construction phase of the development; and
- Support the development of skills within the local community.

9.5.12 Workers Management Plan

The Workers Management Plan (Workers MP) will be developed to address potential risks to worker rights and labour standards by summarizing expectations and procedures to maintain quality working conditions and activities, including accommodation facilities.

The Workers MP will include a detailed labour rights assessment to better understand labour welfare and associated social risks. This assessment will look at the labour rights and welfare for expatriate workforce in practice, in light of the labour regulations described in the Regulatory Study conducted for this Project in February 2018.

The specific objectives of the Workers Management Plan will refer to the following:

- Promote the fair treatment, non-discrimination, and equal opportunity of workers
- Establish, maintain, and improve the worker-management relationship;
- Promote compliance with national employment and labour laws;
- Protect workers, including vulnerable categories of workers such as migrant workers, workers engaged by third parties, and workers in the client's supply chain;
- All expat workers employed should be under equivalent contractual terms and condition terms of Omani workers carrying out similar work;
- Promote safe and healthy working conditions, and the health of workers, also in relation to workers' accommodation camp and housing requirements;
- Establish a formal workers grievance mechanism; and
- Ensure avoidance of child labour and forced labour.

9.5.13 Occupational Health and Safety Plan

The Occupational Health and Safety Plan (OHSP) will be developed to protect workers against adverse health and safety risks, providing measures and actions to be implemented to avoid or mitigate potential adverse. Occupational Health and Safety impacts that may arise from project-related activities, such as potential injuries or accidents.

The OHSP shall comply with the minimum requirements set out in the Ministerial Decision 286/2008 and will be part of a Health and Safety Management System enacted by MARSA LNG LLC. This management system will be enforced throughout the Project including all contractors and sub-contractors. It will include aspects such as regular training and monitoring.

An effective OHSP will support MARSA LNG LLC and Contractors in:

- Avoiding or minimizing risk to and impacts on the OHS of employees and contractor's employees working in the project.
- Defining measures to manage OHS risks to employees and contractors' employees.
- Ensuring compliance with national legislation and international good practices.

9.5.14 Community Health and Safety Management Plan

Worker-community interactions and increased pressure on health resources may expose communities to risks and impacts arising from temporary or permanent changes in population.

The objectives of the Community Health and Safety Management Plan (CHMP) will be to outline potential impacts and describe how these should be avoided, mitigated, managed and monitored.

The specific objectives of the CHMP are the following:

- To establish effective mechanisms for protecting the health and safety of nearby communities from any Project-related health risks;
- To undertake a health facilities capacity/needs assessment;
- To assign roles and responsibilities for all actions;
- To define documentation, and monitoring procedures;
- To determine timescales for implementation; and
- To establish a schedule for periodic review and update of the plan.

The plan will inform the ERP (see Section 9.5.16) with respect to viable scenarios in case of industrial emergencies. This assessment will be conducted prior to start of construction activities in order to gain a better understanding of the adequacy of health facilities to address industrial emergencies during Project operations.

9.5.15 Social Investment Plan and Community Needs Assessment

A social investment benchmarking and community needs assessment will be developed in order to properly manage stakeholders' expectations. As part of this plan, a detailed benchmark of CSR activities by Port tenants in the area as well as a detailed participatory community needs assessment with a focus on the settlements within the direct area of influence will be developed to define and determine key focus areas of action and inform the Project's social investment strategy. Participation in the needs assessment would include the participation of a representative sample of local community members. The Project could partner with a local NGO to lead this work.

The social investment benchmarking and community needs assessment can be conducted independently from the Impact Assessment process; however, it is recommended that it is conducted prior to the start of the operations phase at the latest.

9.5.16 Emergency Response Plan

The Emergency Response Plan (ERP) will provide guidelines related to emergency management and response which can be deployed by MARSA LNG LLC when a significant incident or accident has occurred, or is likely to occur, during project operations.

The ERP details the processes and resources that may be utilised in response to reasonably foreseeable emergency situations. It also defines the location and composition of the emergency response facilities (defined as part of the Community Health and Safety Management Plan, see 9.5.14). It will cover unexpected events likely to endanger the health of employees, visitors and/or contractors; threaten the environment; or create a risk for the integrity of the installations. The document includes:

- basic principles – general organisation, alert procedure, emergency organisation, liaison between different entities during a crisis, medevac procedure, media management, next of kin information, telephone calls management, and briefing and updates
- roles and responsibilities
- specific scenarios and emergency responses – fire/explosion, illness/casualty/ death, road traffic incident, helicopter crash, oil/chemical spill, gas release, loss/ damage to radioactive source, vessel collision, vessel in distress, mass casualty incident, earthquake, terrorism threat and refugees boarding
- forms for recording incidents
- management – training and exercises, update of the plan
- layout and data – charts, maps, layout of facilities, distances between facilities, MSDS
- resources – communication directory, internal emergency resources inventory, external emergency resources inventory.

In addition, a dedicated Oil Spill Contingency Plan (OSCP) will be developed in accordance with MARSA LNG LLC standard GM EP ENV 092 to appropriately manage spills during all phases of the Project (see description in Section 3 Project Description). The plan will include typical industry standard spill management (e.g. drip pans and dedicated work areas) where appropriate and all waste will be appropriately contained before removal to licensed waste facilities.

9.5.17 Decommissioning Plan

MARSA LNG LLC will develop a Decommissioning Plan which will describe how all project assets (including LNG facility, pipelines, jetty, storage area, etc.) which have reached the end of their useful life span, shall be decommissioned and either dismantled and removed. The objective of developing this plan is to return the sites to as close to their former state as possible.

The plan will be produced in accordance with statutory requirements and best industry practices.

The Decommissioning Plan will include at a minimum: risk assessments, environmental impacts, medical aspects, waste destinations, transportation issues, methodologies, restoration and landscaping, legislative issues and monitoring methodology for assurance of correct abandonment procedures. The Decommissioning Plan will be applicable to all phases of the project including construction activities.

9.6 Contractor plans and procedures

The ESMPs described in Section 9.5 provided the basis for subsequent, more detailed management plans prepared by MARSA LNG LLC's key contractors.

Contractors will be required to have their own HSE management systems. Examples of environmental and social related plans/procedures required from the key contractors are listed below.

- HSE plan;
- Waste management plan;
- Hazardous materials management plan;
- Traffic Management Plan;
- Grievance Mechanism;
- Stakeholder Engagement Plan;
- Workers' Management Plan.

In addition, the Contractors will be required to put in place their own Environmental and Social Monitoring Program (see Section 9.7). The specific items to be monitored by the Contractor will be defined between MARSA LNG LLC Oman and the Contractor at the tendering phase stage.

9.7 Environmental and Social Monitoring Program

The environmental, social and health baseline defined background environmental, social and health conditions highlighting critical issues and sensitive components; whereas the impact assessment identified the components likely to experience fundamental negative changes due to project stressors. Based on the baseline and impact assessment outcomes, environmental, social and health monitoring activities to be carried out during the whole life of the Project have been identified.

The basis and guidelines for the monitoring activities will be defined at every stage of the Project cycle. Monitoring will have the following purposes:

- Provide reference to evaluate the effectiveness and to improve the implementation of environmental management plans in an effort to minimize the significant negative impacts.
- Provide an unbiased account of environmental and socio-economic management performance.
- Compliance with the environmental permit issued by EA and any applicable contractual obligations under the agreement with SIPC.

A brief outline of the prospective implementable monitoring plans which will be implemented for the Project are shown below:

- Offshore Environmental Monitoring Plan (jetty and vessels loading or bunkering activities), including sub-plans for each topic (sea water and sediment quality, routine vessel effluent and discharge monitoring, marine fauna, alien species monitoring, the three latter items will be carried out through engagement with SIPC). The Project's Offshore Environmental Monitoring Plan will be defined prior to the start of the Project's activities and will define parameters, frequency and location of monitoring as well as the standards used to assess compliance. It will be updated throughout the Project's lifecycle.
- Onshore Environmental Monitoring Plan (LNG plant), including sub-plans for each topic (noise emissions, light emissions, air emissions and ambient air quality, climate change monitoring, vehicle and equipment maintenance and inspections programme, bird monitoring, the latter carried out through engagement with SIPC). The Project's Offshore Environmental Monitoring Plan will be defined prior to the start of the Project's activities and will define parameters, frequency and location of monitoring as well as the standards used to assess compliance. It will be updated throughout the Project's lifecycle.
- In terms of noise emissions monitoring, this activity will need to be conducted during the construction phase (including in sensitive receptors such as Majis village), which will provide an extended profile of ambient noise at the project boundary and at receptors. The monitoring will be carried out during the subsequent operation and decommissioning phases.

- In terms of soil quality, prior to the commencement of construction, a zero-soil survey to SIPC standards (Version 1.2, March 6, 2014) will be conducted with the purpose to determine the soil quality of the reclaimed land (collecting and analysing metals and trace elements, TPH, aromatics, and PAH) and to have reference composition prior to a tenant's occupation of the land. A new zero-soil survey (as per SIPC standards) will be carried out at the end of the decommissioning phase to assess difference in potential contamination levels in the soil compared to the zero-soil survey carried out prior to the commencement of construction.
- Stakeholder Engagement and Grievance Mechanism. The Project's stakeholder engagement programme will include a process to engage with fishermen throughout the Project's lifecycle through continuous engagement. Details regarding the stakeholder engagement plan are provided in Appendix B. The Project's grievance mechanism will include provisions specific for grievances associated with fishing. The grievance mechanism will be widely disclosed and regular refreshers to stakeholders about the Grievance Mechanism will be provided, Grievances will be monitored to determine patterns or trends and corrective actions taken as required.

In all cases, an appropriately qualified professional is required to evaluate and report the performance of management plans in achieving their objectives. Gaps and corrective measures need to be documented and verified as needed.

9.8 Planning and Implementation

9.8.1 Training and Awareness

MARSA LNG LLC Oman will identify, plan, monitor, and record training needs for personnel whose work may have a significant adverse impact upon the environment or social/health conditions. The project recognises that it is important that employees at each relevant function and level are aware of the project's environmental and social/health policy; potential impacts of their activities; and roles and responsibilities in achieving conformance with the policy and procedures.

Training and awareness (raising) therefore forms a key element of both EHS/operational control and the expediting of this framework ESMP. Key staff will, therefore, be appropriately trained in key areas of EHS management and operational control with core skills and competencies being validated on an on-going basis.

The identification of training and awareness requirements and expediting of the identified training/awareness events will be the responsibility of the MARSA LNG LLC Oman Human Resources Manager.

The HSE Manager, in cooperation with the Department Managers, shall coordinate people to attend their designated HSE training and monitor attendance in the HSE Training Matrix. As part of the training all employees shall be made aware of:

- The importance of conformity with the HSE Guidelines, Protocols, Standards, Procedures & the requirements of the Project ESMP.
- The significant HSE hazards & associated risks and potential impacts associated with their work, and the HSE benefits of improved personal performance.
- Their roles & responsibilities in achieving conformity with the requirements of the Project ESMP.
- The potential consequences of departure from specified procedures.

Specific knowledge or skill gaps that are identified for any person through the application of the competency assessment process can be met through either formal training or structured learning & development in the workplace. Training to close competency deficiencies may be coordinated by the HR Department or by the respective Department (e.g., on-the-job training).

Subcontractors engaged during the pre-Operations phase of the development will be responsible for the training and awareness of their staff. As a minimum it is expected that this will cover the environmental and social setting within which the work is carried out; the potential environmental and social impacts of their work activities; the management and mitigation measures to address these; and the existence of, and importance of complying with, the MARSA LNG Bunkering Project ESMP.

9.8.2 Communication

MARSA LNG LLC Oman will maintain a formal procedure for communications with the relevant authorities through its Stakeholder Engagement Plan (SEP).

The HSE Manager is responsible for communication of EHS issues to and from relevant authorities. This is coordinated with the project's Communications and External Relations Manager. The General Manager will be kept informed of such communications. Pertinent information arising from such interactions will be communicated to subcontractors through the EHS Manager.

Whereas it is anticipated that the subcontractor EHS staff may interact with representatives from regulatory or port authorities on an informal, day-to-day basis regarding routine matters, the HSE Manager shall be the point of contact for formal communications. The HSE Manager will be responsible for communicating any pertinent information arising from such discussions to appropriate subcontractor through the technical department.

Internal communication is used to ensure that all persons are aware of the:

- HSE risks posed by their work activities & the controls to minimize these risks.
- Emergency response procedures that are in place.
- Lateral learning points arising from incident investigations.

MARSA LNG LLC Oman uses several mechanisms to communicate to employees, recognizing at all times the possible cultural differences that exist. These include meetings, workshops, forums, presentations, phone, e-mail, and noticeboards.

The Company will hold several regular meetings that relate to the implementation and functioning of the Project ESMP. The highest-level forum in the Company dedicated to HSE issues is the HSE Steering Committee. The aims of the HSE SC are to:

- Monitor execution of the HSE Plan.
- Monitor progress towards the HSE objectives and annual performance targets.
- Ensure appropriate resources are available to implement the HSE Plan.
- Review incident investigations.

9.8.3 Documentation & Document Control

MARSA LNG LLC Oman will control HSE documentation, including management plans; associated procedures; and checklists, forms and reports, through a formal procedure. This document control procedure describes the processes that the project will employ for official communication of both hardcopy and electronic documents. In addition, it describes the requirement for electronic filing and posting and for assignment of a document tracking and control numbers (including revision codes).

The documents determined by the Company as necessary to ensure the effective planning, operation and control of the processes that relate to the Company's significant HSE risks are listed in the HSE MS Document List and are organised in line with the hierarchical structure shown in Figure 9-3.

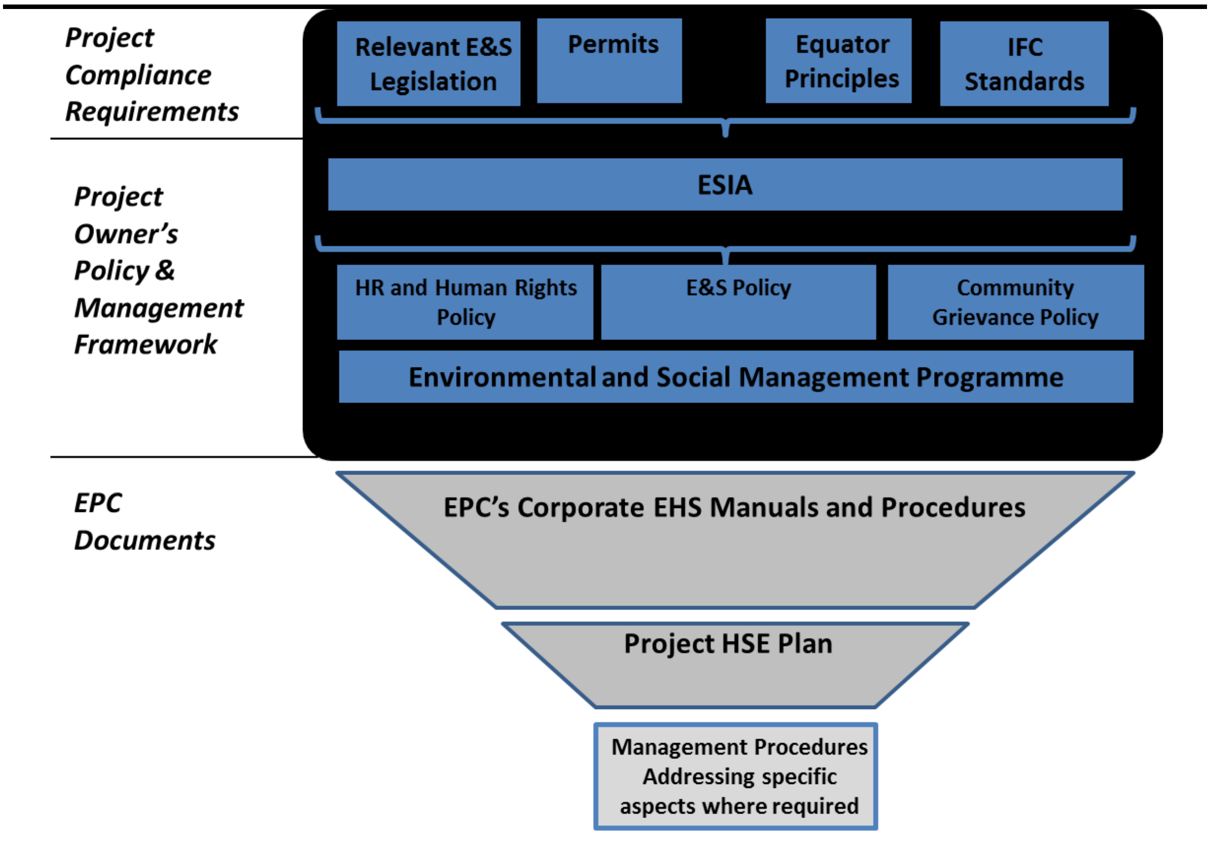


Figure 9-3 HSE MS Documentation Hierarchy for the Project

During operations, the HSE Manager will be responsible for maintaining a master listing of applicable EHS documents and making sure that this list is communicated to the appropriate parties. The EHS Manager will be responsible for providing notice to the affected parties of changes or revisions to documents, for issuing revised copies and for checking that the information is communicated within that party's organisation appropriately.

Subcontractors will be required to develop a system for maintaining and controlling their own EHS documentation and describe these systems in their respective EHS plans.

9.8.4 Operational Control

Each potentially significant impact identified in the ESIA will have an operational control associated with it that specifies appropriate procedures, work instructions, best management practices, roles, responsibilities, authorities, monitoring, measurement and record keeping for avoiding or reducing impacts.

It is the responsibility of the Department Managers to develop and implement operational control documents (e.g., Operating Manuals & Procedures). These should always be in place for HSE Critical Activities. It is also important that Procedures include measures aimed at improving HSE performance or managing HSE risk, in addition to controlling activities and tasks.

It is the responsibility of Contractors to develop and implement operational & activity control documents (i.e., Standards, Procedures & Work Instructions) for all HSE-Critical Activities which they undertake on behalf of the Company. Where relevant, these Procedures must, as a minimum, meet the performance criteria defined in MARSA LNG LLC OMAN's HSE Standards.

9.9 Implementation and Monitoring

Continual examination by MARSA LNG LLC Oman of the performance of the ESMP as well as actual performance against HSE targets, are necessary to gauge whether progress is being made towards the strategic HSE objectives of the Company. Full implementation of the ESMP means that people are doing as directed by the Management System at all levels.

In order to comply with Good International Industry Practice (GIIP) and MARSA LNG LLC HSE policy, effective implementation involves:

- Setting performance targets and key performance indicators (KPIs);
- Monitoring to measure performance against targets;
- Keeping performance monitoring records;
- Addressing non-compliance & ensuring that corrective action is taken;
- Reacting to incidents to make sure that they are reported & investigated.

9.9.1 Monitoring & Measurement

Monitoring will be conducted to ensure compliance with regulatory requirements as well as to evaluate the effectiveness of operational controls and other measures intended to mitigate potential impacts.

With respect to the impacts identified in the ESIA, MARSA LNG LLC Oman will develop a number of programs to monitor the effectiveness of the mitigation measures (Section 9.4). The Environmental and Social monitoring plans have been defined in Section 9.7 and will describe what effect is to be measured and the frequency.

The monitoring programs shall:

- Identify the information to be obtained;
- Define the required accuracy of the results;
- Specify the monitoring methods and identify monitoring locations;
- Specify the frequency of measurement;
- Define roles and responsibilities for monitoring.
- RESPONSES TO SIPC COMMENTS ESIA REPORT VERSION B

9.9.2 Reporting

Throughout the project, MARSA LNG LLC Oman will keep regulatory authorities, lenders and other relevant stakeholders informed of the project performance with respect to HSE matters. In order to comply with Good International Industry Practice (GIIP) and MARSA LNG LLC HSE policy, MARSA LNG LLC Oman will release corporate annual reports on environmental and social performance which will be available to the public via MARSA LNG LLC's website. The content will be determined with consideration of the environmental permit delivered by EA (where the Omani's reporting obligations are specified), national requirements and lender requirements.

9.10 Compliance Evaluations and Audits

Identifying potential impacts, hazards and risks is an important part of the ESMP. Equally important is the investigation of 'near miss' or accidents/incidents so that valuable lessons and information can be learnt and used to prevent similar or more serious occurrences in the future.

MARSA LNG LLC shall require all contractors to operate in accordance with the established Project Standards (see Section 2) and evaluate compliance with these standards periodically. The evaluation shall be documented and the EPC is required to take action to respond to any non-compliances that are identified.

Non-compliance may be sudden and temporary or it may persist for long periods. It may result from deficiencies or gaps in the ESMP itself, failures in plant or equipment, or from human error. Non-compliance can be reported directly by those in control of activities or found through inspections and audits of activities.

Investigations should fully establish the root causes including failures in the ESMP. Investigations enable the planning of corrective action including measures for:

- Restoring compliance as quickly as possible;
- Preventing any recurrence;
- Evaluating and mitigating any resultant adverse HSE effects;
- Assessing the effectiveness of the above measures.

MARSA LNG LLC shall also require the contractor to audit the effectiveness of their own EHS Management Systems at periodic intervals, using established and appropriate audit processes, to verify that the system aligns with Project standards, has been properly implemented and maintained, and is effective in meeting the policies and objectives that MARSA LNG LLC has defined for the Project with the EPC.

Records of the audit will be provided to MARSA LNG LLC. The EPC shall establish inspection and auditing procedures aligning with MARSA LNG LLC requirement.

With respect to communities and social management, MARSA LNG LLC will carry out regular reviews to assess the extent to which E&S management and community relations at the Project align with MARSA LNG LLC's project policies, strategic objectives and Project commitments.

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APPENDIX A PROJECT APPLICABLE NATIONAL LEGISLATIVE FRAMEWORK

No h

Appendix A – Project applicable National Legislative Framework

MARSA LNG Bunkering Project, Sohar, Oman

20/10/2023

Project No.: 0523586

The business of sustainability

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CONTENTS

CONTENTS I

List of Tables i

1. APPLICABLE NATIONAL ENVIRONMENTAL LEGAL FRAMEWORK 1

1.1 Oil and Gas Law 1
1.2 Air Quality & Emissions 2
1.2.1 National Air Quality Standards & Emissions 2
1.2.2 International Air Quality Standards and Emissions 4
1.2.3 Air Quality & Emission Limits Applicable to the Project 5
1.3 Noise 6
1.3.1 National Noise Legislation 6
1.3.2 International Guidelines for Noise 7
1.3.3 Noise Limits Applicable to the Project 7
1.3.4 Waste Management 8
1.4 Social 13
1.4.1 Personal Data Protection Law 13

List of Tables

Table 1.1 Ambient Air Quality Standards 2
Table 1.2 Emission Standards for Oil and Gas Developments (MD118/2004) 3
Table 1.3 WHO Ambient Air Quality Guidelines 4
Table 1.4 Relevant International Emission Guidelines and Standards 5
Table 1.5 National Ambient Noise Limits 7
Table 1.6 IFC Environmental Health and Safety Guidelines 7
Table 1.7 Wastewater Discharge and Re-use Standards - Part A, Categories 10
Table 1.8 Wastewater Discharge and Re-use Standards - Part B, Specifications 11
Table 1.9 Condition of Sludge for Application to Land 12

1. APPLICABLE NATIONAL ENVIRONMENTAL LEGAL FRAMEWORK

1.1 Oil and Gas Law

The Oil and Gas Law (RD8/2011) was promulgated in January 2011 and critically addresses environmental and social issues and supersedes the Petroleum and Minerals Law (RD42/1974). Strict penalties are imposed through RD8/2011 in the event of non-compliance. Pertinent to environmental management, the following should be noted under the Oil and Gas Law (RD8/2011):

- Execute operations with due diligence according to technical standards stipulated in the concession agreement and international agreements to which Oman is a party to.
- Ensure the protection of the environment, including:
  - Treat all wastes prior to disposal to protect to environment and water sources;
  - Do not dispose of gas unless it is necessary, and by using suitable means to protect the environment;
  - Take all the precautions and arrangements required when acquiring, transporting, handling or using hazardous materials during the operations, including its waste, and potentially explosive, pressurized, flammable, oxidizing, toxic, irritant, corroding and radioactive materials and liquids, together with obtaining insurance against responsibility for any damage that may result from such materials;
  - Protect all the geological formations containing freshwater and their adjoining aquifers;
  - Do not waste water resources - Not to use potable or irrigation water to inject the oil wells unless it is absolutely necessary, due to lack of alternative, and after obtaining the permit required from the concerned authorities;
  - Do not re-inject oil associated water into the ground without partial treatment according to the applicable rules and regulations;
  - Restore abandoned wells;
  - Prevent leakage of petroleum products;
  - Mitigate against pollution;
  - Have contingency plans in place to reduce environmental impacts from explosions and accidents that may occur in the operation sites;
  - In case of incident, inform the concerned authorities of the incident and the steps taken to control it;
  - Limit and reduce greenhouse gas emissions;
  - Use best available technologies and materials to ensure safety and protection of the environment – apply ALARP.
- Plan for 25m wide buffer zones for either side of pipelines;
- Do not carry out O&G operations within 200m of cities, villages, roads, mosques, graveyards, archaeological areas, natural reserves, natural wildlife reserves, dams, irrigation systems (Falaj), wells, restricted areas or any other installation;
- Do not construct any installation within 500m of Ministry of Defence and the Sultan's Armed Forces land, installations and camps, unless authorized by those parties;
- Inform concerned authorities in writing in the event that there is an accident that seriously affects the right of the concession holder/third parties, or exposes the environment, public properties or workers to serious damage;

- Do not carry out any operation that may infringe on the right of third parties;
- Do not assign or waive any of the rights or obligations stipulated in the concession agreement without prior written approval from the ministry;
- Comply with the terms of the concession agreement and all the permits and approvals issued by the MOG or other government authorities, and the provisions of the laws, rules and regulations applicable in the Sultanate of Oman;
- Acquire insurance against all types of risks including against any damage to individuals, properties, public safety or environment resulting from, or caused by operations;
- Plan to decommission certain infrastructure and restore the concession to its natural condition; and
- The concession agreement does not automatically give a right of ownership within the concession area.

Pertinent to social welfare the following stipulations should be noted under the Oil and Gas Law (RD8/2011):

- Employ qualified national manpower;
- Prepare training programmes to train and qualify Omani nationals for professional and technical jobs and senior posts and responsibilities relating to operations;
- Replace the expatriate workforce, in coordination with the Ministry of Manpower;
- Provide protection to the workforce at project sites; and
- Implement the requirements of the Labour Law and workers' agreed contract conditions.

1.2 Air Quality & Emissions

1.2.1 National Air Quality Standards & Emissions

1.2.1.1 National Ambient Air Quality Standards

The Ambient Air Quality Regulation (No. 41-2017) was introduced in 2017 and stipulates ambient air quality standards (Table 1.1).

Table 1.1 Ambient Air Quality Standards

Pollutant	Symbol	Maximum Level of Pollutant Concentrations		Average Pollutant Measurement Period
		ppm	µg/m^3	
Sulphur Dioxide	SO_2	0.124	350	Hour
		0.0532	150	(24) hours
Hydrogen Sulphide	H_2S	0.020	30	Hour
Nitrogen Dioxide	NO_2	0.123	250	Hour
		0.642	130	(24) hours
Ozone	O_3	0.0568	120	(8) hours
Particulate Matter 10 Microns	PM_{10}	-	150	(24) hours

Pollutant	Symbol	Maximum Level of Pollutant Concentrations		Average Pollutant Measurement Period
		ppm	µg/m³	
Particulate Matter 2.5 Microns	$PM_{2.5}$	-	65	(24) hours
Carbon Monoxide	CO	24.3	30 mg/m³	Hour
		8.11	10 mg/m³	(8) hours
Non-methane Hydrocarbon	NMHC	0.24	160	(3) hours
Lead	Pb	-	1.5	(3) months
Ammonia	NH_3		200	(24) hours

1.2.1.2 National Source Emission Standards

Air quality related to a permanent stationary source with a permanent stack or chimney is typically regulated through the air quality law (MD118/2004). General requirements state that, 'Dark smoke products of combustion shall not emit smoke as dark or darker than shade 1 on the Ringlemann Scale (20% opacity),' and that grit and dust emissions should not exceed the maximum permissible limit of 50 mg/m³. Emission standards for oil and gas developments from MD118/2004 are provided in Table 1.2.

Table 1.2 Emission Standards for Oil and Gas Developments (MD118/2004)

Pollutant	Unit	MD118 18a - Firing Sources (Factories Boilers, Kilns and Melting Kilns)	MD118 21b – Metal Works - Furnace (Kiln) operated with diesel oil or gas	MD118 9 - Incineration Works	FLARE AND VENTS - not permanent	MD118 12 Flaring in Refinery and Petroleum Fields
Carbon Monoxide	g/m³	0.050	0.050	-	0.050	0.050
Carbon Dioxide	g/m³	-	-	-	5	5
Dioxin (as furans)	ng/m³	-	-	0.5	-	-
Hydrogen Chloride	g/m³	-	-	0.050	-	-
Hydrogen Fluoride	g/m³	-	-	0.010	-	-
Hydrogen Sulphide	ppm	-	-	5	-	-
Unburnt hydrocarbons	g/m³	0.010	0.010	-	-	0.010
Nitrogen Dioxide	g/m³	0.150	0.150	0.200	-	0.150
Nitrogen Oxides	g/m³	-	-	-	0.150	-
Phosphorus Compound	g/m³	-	-	0.050	-	-
Sulphur Dioxide	g/m³	0.035	0.035	-	-	0.035
VOCs		-	-	-	-	-
Total particulates	g/m³	0.1	0.1	0.050	-	0.100
Sulphur recovery efficiency	%	-	-	-	-	-

Pollutant	Unit	MD118 18a - Firing Sources (Factories Boilers, Kilns and Melting Kilns)	MD118 21b – Metal Works - Furnace (Kiln) operated with diesel oil or gas	MD118 9 - Incineration Works	FLARE AND VENTS - not permanent	MD118 12 Flaring in Refinery and Petroleum Fields
PM10		-	-	-	-	-
Fluorine	g/m^3	-	0.003	-	-	-
Benzene	g/m^3	-	-	-	-	-
Oxygen	%	-	-	-	-	-

1.2.2 International Air Quality Standards and Emissions

The IFC Environmental, Health and Safety General (EHS) Air Emissions and Ambient Air Quality, which refers to the WHO Ambient Air Quality Guidelines, set international standards relating to the air quality standard as reported in the following Table 1.3). IFC Guideline reports that “Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines”

Table 1.3 WHO Ambient Air Quality Guidelines

Pollutant	WHO / IFC Value	Averaging Period
Sulphur Dioxide (SO_2)	500	10 min
	-	1 hr
	20	24 hr
Nitrogen Dioxide (NO_2)	200	1 hr
	-	24 hr
	40	Annual
Particulate Matter 10 micrometers (PM_{10})	50	24 hr
	20	Annual
Particulate Matter 2.5 micrometers ($PM_{2.5}$)	25	24 hr
	10	Annual
Carbon Monoxide (CO)	-	1 hr
	-	8 hr
Ozone (O_3)	100	8 hr

IFC have also define specific emission standards for this type of facility. In particular the IFC Environmental, Health, and Safety Guidelines for Liquefied Natural Gas Facilities (April 2017), reports, that for the management of combustion sources with a capacity of lower or equal to 50 megawatt thermals (MWth), including air emission standards for exhaust emissions, is provided in the General EHS Guidelines, shown in the Table 1.4 below.

Table 1.4 reports the emission limits defined by the EU Emission Directive Best Available Techniques, emission limits mandatory for the relevant facilities in European Union. Table below includes the emission standards from the Best Available Techniques (BAT) Reference Document for the Refining of Mineral Oil and Gas.

Table 1.4 Relevant International Emission Guidelines and Standards

Pollutant	Unit	IFC Combustion Facility Emissions Guidelines[1]		IED Requirements	
		Gas Engine	Gas Boiler	Refineries BAT Conclusions Daily average	
Carbon Monoxide	g/m^3	-	-	0.1	
Carbon Dioxide	g/m^3	-	-	-	
Dioxin (as furans)	ng/Nm^3	-	-	-	
Hydrogen Chloride	mg/Nm^3	-	-	-	
Hydrogen Fluoride	mg/Nm^3	-	-	-	
Hydrogen Sulphide	ppm	-	-	-	
Unburnt hydrocarbons	g/m^3	-	-	-	
Nitrogen Dioxide	g/m^3	-	-	-	
Nitrogen Oxides	g/m^3	0.20 Spark Ignition 0.40 Dual Fuel 1.60 Compression Ignition	0.32	0.03 to 0.1	
Phosphorus Compound	g/m^3	-	-	-	
Sulphur Dioxide	g/m^3	-	-	0.005 - 0.035	
VOCs		-	-	0.15 - 10	
Total particulates	g/m^3	-	-	0.005 - 0.025	
Sulphur recovery efficiency	%	-	-	99.5 – 99.9%	
PM10		-	-	-	
Fluorine	g/m^3	-	-	-	
Benzene	g/m^3	-	-	0,001	
Oxygen	%	15	3	3	

1.2.3 *Air Quality & Emission Limits Applicable to the Project*

As required by the IFC standard, the project will comply to the National Air Standard.

Regarding the emission standard, the project will comply to the EU BAT Standard as more stringent than the local and IFC standards.

[1] ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES FOR LIQUEFIED NATURAL GAS FACILITIES (April 2017), reports that for the management of combustion sources with a capacity of lower or equal to 50 megawatt thermals (MWth), including air emission standards for exhaust emissions, is provided in the General EHS Guidelines.

1.3 Noise

1.3.1 National Noise Legislation

National noise legislation includes MD 79-94 and MD 80-94 (regulations for noise pollution control in the public / working environment respectively).

Noise Pollution Control in the Public Environment (MD 79-94)

Noise Pollution Control in the Public Environment is controlled through MD 79-94 which identifies noise sources attributable to operations, namely noise associated with construction work itself. The Ministerial Decisions contain the following articles that are pertinent to the Project:

Article 2: External Noise Sources are:

a) Industrial plants and public works: Include factories, similar commercial facilities, and the like as well as the works of assembling, dismantling and repair. It will also include public works, power plants and installation for extraction, pumping and refining of water, oil, gas, sewage treatment etc.

MD 79-94 also defines the weighting and the reference level for the noise measurements being taken, lists penalties to be included for tonal or impulse noise, and defines the three sub-daily reference periods. The corresponding articles from the MD 79-94 are listed below:

Article 3: Public noise shall be described in terms of emission values expressed by the equivalent continuous A -weighted sound pressure level over relevant time intervals, in decibels relative to 20 micro pascals.

Article 4: For noise of tonal or impulse character, an adjustment shall be made to the measured or calculated value of the equivalent continuous A -Weighted sound pressure level of the noise. This shall be as follows:

b) For tonal noise, the adjustment shall be 5 dB (A).
c) For impulse noise, the adjustment shall be 5dB (A).
d) For the noise of combined tonal and impulse character the adjustment shall be 7 dB (A).'

Article 6: For noise from sounds described in items a, b, and c of Article (2), the time limits of noise occurring in specific parts of the day and night for working days versus holidays shall be as follows:

a) Workdays - daytime (A): After seven a.m. up to six p.m. LMT
b) Workdays- Evenings (B): After six. p.m. up to eleven p.m. LMT
c) Holidays and Nights (C): After eleven. p.m. up to seven a.m. LMT

Article 7: The limits of noise generated from the sources enlisted in item (a) of Article (2), in terms of equivalent continuous A-weighted sound pressure level over each particular time period A, B, C as defined in Article (6) shall be:

Legislative limits for A-weighted, time averaged equivalent noise level (as a result of construction activities) are defined in Table 1.5 with the relevant district type (industrial) highlighted in bold.

Table 1.5 National Ambient Noise Limits

Type of District	Leq, T, dB (A) Over Time Period		
	A	B	C
Rural Residential Recreational	45	40	35
Suburban Residential	50	45	40
Urban Residential	55	50	45
Urban Residential with Some Workshops or Business; City Hub	60	55	50
Industrial and Commercial	**70**	**70**	**70**

Noise Pollution Control in the Working Environment (MD 80-94)

Noise Pollution Control in the Working Environment is controlled through the MD 80-94.

Article 4 defines the legislative exposure limit of workers on site to an A-weighted, time averaged equivalent noise level of 85 dB(A).

Article 4: The noise level which an employee working in a workshop is exposed to shall be 85 dB(A).

1.3.2 International Guidelines for Noise

The IFC Environmental, Health and Safety General (EHS) Guidelines for Noise, which refers to the WHO Guidelines for Community Noise, set international noise standards relating to noise from industrial plants at the property line and in residential areas.

The IFC HSE guidelines prescribe an absolute noise level of 55 dB(A) during the daytime and 45 dB(A) during night time value in residential areas. For industrial area, the applicable noise level is 70 dB(A) at the boundary of an industrial property. These limits refer to noise from facilities and stationary noise sources, and are commonly applied as design standards for industrial facilities. Moreover, according to IFC guidelines, the Project should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

The IFC standards are summarized in Table 1.6

Table 1.6 IFC Environmental Health and Safety Guidelines

	Maximum permissible noise limits dB(A) (Leq)	
Receptor	**Daytime (07:00 – 22:00)**	**Night-time (22:00 – 07:00)**
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Source: IFC Environmental, Health and Safety (EHS) General Guidelines, 2012

1.3.3 Noise Limits Applicable to the Project

The SIPC area where the LNG site is located will be classified as “industrial area”, whereas the surrounding environment and the nearest settlements can be classified as “urban residential area”.

The Project will apply the most stringent noise limits set by national and IFC standards, as follows:

- during daytime, 55 dB(A) for residential areas (national and IFC standards) and 70 dB(A) for industrial areas (national and IFC standards);
- during evening, 50 dB(A) for residential areas (national standards) and 70 dB(A) for industrial areas (national and IFC standards);
- during night-time, 45 dB(A) for residential areas (national and IFC standards) and 70 dB(A) for industrial areas (national and IFC standards).

1.3.4 Waste Management

1.3.4.1 Management of Solid Non-Hazardous Waste (MD 17/1993)

Solid Non-hazardous Waste is classified as any solid material or semi solid which does not have any danger to the environment or human health (if it is dealt with in a safe scientific way) and can include:

- Household waste (solid non-hazardous materials generated from domestic activities);
- Solid materials or semi solid material discarded or produced from residential, commercial, industrial, agricultural, and other activities;
- Construction and demolition debris;
- Metal scrap such as discarded motor vehicles;
- Dewatered sludge from domestic, industrial, or agricultural wastewater treatment that contains no toxic constituents in concentrations in excess of those acceptable within the terms of wastewater regulations; and
- Slag and ashes from incineration processes that have an available toxic content within the criteria applied to the characterization of dewatered sludge from wastewater treatment.

The Ministerial Decree contains the following articles pertinent to the Project site:

Article 2: Occupants of premises used for residential, commercial, industrial, agricultural or other purposes shall store and dispose solid non-hazardous waste in accordance with the provisions of these Regulations and the decision of the Concerned Authority to this effect, such that there is no nuisance or hazard to the public health.

Article 3: The Concerned Authority shall establish a suitable system for the collection, storage and transport of all solid non-hazardous waste arising within its specialized area towards all residential complexes, other than residential complexes of less than 500 inhabitants which can be excluded by a decision from the Minister, provided that no nuisance or hazard to the public health is risked thereby.

Article 5: The user of commercial, industrial, agricultural or any other sites that produce solid non-hazardous waste except domestic waste, shall collect these wastes and transport it in a safe manner to a site designated by the Concerned Authority for this purpose, unless this Authority decides else Article 4 is followed.

Article 6: In areas where collection systems have been established the Concerned Authority shall provide the necessary number of waste containers and points shall be allocated for the collection of this waste. It is not permitted for any person to dispose of solid non-hazardous waste in places other than these places.

Article 11: The Concerned Authority shall ensure that treatment and disposal of solid non-hazardous waste within its area of responsibility are carried out without creating any health or environmental hazard.

Article 13: No solid non-hazardous waste should be mixed with any category of hazardous waste at any time.

1.3.4.2 Management of Hazardous Waste (MD 18/1993)

Article 1 of MD 18/1993 states that Hazardous Waste is classified as any waste arising from commercial, industrial, agricultural, or any other activities which (due to its nature, composition, quantity or any other reason) is hazardous or potentially hazardous to human health, plants or animals, air, soil or water. This includes explosive, radio-active or flammable substances; which may cause disease as well as those issued by a decision from the Minister. The Ministerial Decree also contains the following articles that may be pertinent to the Project:

Article 4: No hazardous waste shall be mixed with any other category of waste nor shall it be discharged to a common or other internal or external sewerage or other drainage system without a licence from the Ministry.

Article 5: Every hazardous waste generator shall complete a Consignment Note for each category of hazardous waste before the hazardous waste leaves his land or premises.

Article 6: All hazardous waste shall be labelled and packed according to the Ministerial Decision issued in this respect.

Article 8: Every hazardous waste generator shall store hazardous waste in approved storage facilities on his land or at his premises until its removal in accordance with the terms of the licence issued by the Ministry.

Article 9: Hazardous waste shall be transported by transporters licensed by the Ministry to collect, handle, store and dispose hazardous waste outside the waste generator's premises. This licence will be issued with conditions after the approval of Royal Oman Police.

Article 10: Every owner of any site where hazardous waste is to be stored, shall apply for a licence from the Ministry and shall operate the site only in accordance with the terms of the issued licence which shall include a requirement that all hazardous waste received at the site shall be accompanied by appropriate Consignment Note(s) in accordance with Article (5).

1.3.4.3 Chemical Management

The organization of handing and use of chemicals law (MD25/2009) defines a “Chemical’ is any substance, enlisted, as hazardous material according to the International Classification of Hazardous Material, which affects the public health or the environment. The following articles under MD25/2009 have relevance:

Article 2: The user of the chemical substance, in the event of storage, shall comply with the following conditions:

- Store chemicals in designated areas away from industrial activities, each type to be separated, and a partition of 10 m width shall be made between the flammable materials and any source of combustion and they shall be separated from any facility for the production of flammable materials by 3 m.
- They shall be stored in an orderly and harmonized manner with labelling of each chemical showing its common name, chemical composition and degree of risk, with chemical containers not to be placed on each other in an accumulated manner, and flammable materials to be kept away for a distance of not less than one meter from the warehouse doors.

- The roofs of the store shall be designed in such a manner that prevents accumulation of smoke which may result from any fire.
- The store shall have at least two emergency gates for use in emergency cases with emergency signs affixed to the gates.
- The floor of the store shall be lined with impermeable materials, preventing any shock or electrical short, non-slippery and its walls and structures shall be non-flammable.
- The store shall have outlets and back-up emergency ducts in case of leakage of rain water.
- Electrical connections shall not be bare, shall be connected in parallel and maintained to permanently ensure their safety.
- The store shall be provided with adequate and secure lighting at all times and the operating keys shall be outside the store near its gate.
- The store shall be far from any source of heat or any flammable source.
- It shall contain odours, gases and smoke suction and exhaust devices.
- The store shall be well ventilated with sound insulation to prevent any echo, which may lead to fall or collision accidents.
- The store shall be provided with security and safety devices to be decided by the competent authorities.
- The store shall contain guidelines and warning signs of various types of risks.
- The store entrances shall be controlled, monitored and supervised in a safe and sound manner with prohibition of entry to non-authorized staff.
- Review the Material Safety Data Sheets when a chemical substance spills, leaks, or any other emergency incidents.
- No construction, extension or change in the store or any removal works unless after the approval of the Ministry and The Directorate General of Civil Defence, Royal Oman Police.

1.3.4.4 Wastewater Re-Use and Discharge (MD145/93)

The re-use and discharge of wastewater to the terrestrial environment is regulated by the Wastewater Re-Use and Discharge law (MD145/93). Applicable wastewater re-use and discharge standards are presented in Table 1.7 and are Oman's common standard. These standards are also referred to as RD115/2001 (Law on Protection of Sources of Potable Water from Pollution).

Table 1.7 Wastewater Discharge and Re-use Standards - Part A, Categories

Specification	Standard A	Standard B
Crops	Vegetables likely to be eaten raw. Fruit likely to be eaten raw and within 2 weeks of any irrigation.	Vegetables to be cooked or processed. Fruit if no irrigation within 2 weeks of cropping. Fodder, cereal and seed crops.
Grass and ornamental areas	Public parks, hotel lawns, recreational areas. Areas with public access. Lakes with public contact (except places which may be used for praying and hand washing).	Pastures. Areas with no public access.

The maximum permissible concentrations of various pollutants in the treated wastewater are as specified Table 1.8.

Table 1.8 Wastewater Discharge and Re-use Standards - Part B, Specifications

Parameter mg/L except where otherwise stated	Standards[1]	
	A	B
Biochemical Oxygen Demand (BOD) (5d@20°C)	15	20
Chemical Oxygen Demand (COD)	150	200
Suspended Solids (SS)	15	30
Total Dissolved Solids (TDS)	1,500	2,000
Electrical Conductivity (EC) (µS/cm)	2,000	2,700
Sodium Absorption Ratio (SAR)	10	10
pH (within range)	6-9	6-9
Aluminium (as Al)	5	5
Arsenic (as As)	0.100	0.100
Barium (as Ba)	1	2
Beryllium (as Be)	0.100	0.300
Boron (as B)	0.500	1
Cadmium (as Cd)	0.010	0.010
Chloride (as Cl)	650	650
Chromium (total as Cr)	0.050	0.050
Cobalt (as Co)	0.050	0.050
Copper (as Cu)	0.500	1
Cyanide (total as CN)	0.050	0.100
Fluoride (as F)	1	2
Iron (total as Fe)	1	5
Lead (as Pb)	0.100	0.200
Lithium (as Li)	0.070	0.070
Magnesium (as Mg)	150	150
Manganese (as Mn)	0.100	0.500
Mercury (as Hg)	0.001	0.001
Molybdenum (as Mo)	0.010	0.050
Nickel (as Ni)	0.100	0.100
Nitrogen: Ammoniacal (as N)	5	10
: Nitrate (as NO_3)	50	50
: Organic (Kjeldahl) (as N)	5	10
Oil and Grease (total extractable)	0.500	0.500
Phenols (total)	0.001	0.002
Phosphorus (total as P)	30	30
Selenium (as Se)	0.020	0.020

Parameter mg/L except where otherwise stated	Standards[1]	
	A	B
Silver (as Ag)	0.010	0.010
Sodium (as Na)	200	300
Sulphate (as SO_4)	400	400
Sulphide (total as S)	0.100	0.100
Vanadium (as V)	0.100	0.100
Zinc (as Zn)	5	5
Faecal Coliform Bacteria (per 100 mL)	200	1,000
Viable Nematode Ova (per litre)	<1	<1

[1] *Standards relate to the different acceptable areas of application for wastewater re-use.*

While primarily applicable for the application of sludge to agricultural land, as per MD17/93, any sludge to be disposed of as a non-hazardous waste must comply with the concentrations presented in Table 1.9.

Table 1.9 Condition of Sludge for Application to Land

Metal	Maximum concentration (mg/kg of dry solids)	Maximum Application rate (kg/ha) *	Maximum permitted concentration in soil (mg/kg of dry solids)
Cadmium	20	0.150	3
Chromium	1,000	10	400
Copper	1,000	10	150
Lead	1,000	15	150
Mercury	10	0.100	1
Molybdenum	20	0.100	3
Nickel	300	3	75
Selenium	50	0.150	5
Zinc	3,000	15	300

* Based on a ten-year average and a soil pH > 7.0

After the spreading of sludge there must be a minimum period of three weeks before grazing or harvesting of forage crops. Sludge use is prohibited:

- On soils whilst fruits or vegetable crops (other than fruit trees) are growing or being harvested;
- For six months preceding the harvesting of fruit or vegetables, which grow in contact with the soil and which are normally eaten raw; and
- On soils with a PH < 7.0.

1.4 Social

1.4.1 Personal Data Protection Law

The promulgation of the personal data protection law (RD 6/2022) issued February 2022 in Official Gazette No 1429 explicitly outlines the protection of personal data under the provisions of this law.

The provisions of this law shall apply to the processing of personal data which has been defined as *Data that identifies or can identify a natural person directly or indirectly, based on one or more identifiers, such as name, national ID number, electronic identifiers, location data, or one or more factors specific to the genetic, physical, mental, psychological, social, cultural, or economic identity.*

Article in the Royal Decree that is applicable to the Project:

Article 5: The processing of personal data related to genetic data, biometric data, health data, racial or ethnic origin, sexual life, political opinions, religious or philosophical beliefs, criminal convictions, or data concerning security measures is prohibited unless authorized by the ministry in accordance with the regulations and procedures specified by the law.

Rights of the Data Subject:
1. Personal data must not be processed without explicit consent from the data subject.
2. The data subject has the right to withdraw their consent, request modification or blocking of their data, obtain a copy of their data, transfer their data to another controller, request erasure of their data (unless required for national preservation), and be notified of any data breaches.
3. The regulation will specify controls and procedures for exercising these rights.
4. Data subjects can file complaints with the Ministry if they believe their data processing violates the law.

The provisions of this law do not apply to the processing of personal data in certain circumstances, including cases related to national security, public interest protection, execution of tasks by governmental entities, legal obligations, protection of state interests, vital interests of the data subject, criminal offence detection or prevention, contract execution, personal or family contexts, authorized research purposes, and publicly available data not contradicting the law.

APPENDIX B STAKEHOLDER ENGAGEMENT PLAN

Appendix B - Stakeholder Engagement Plan

MARSA LNG Bunkering Project, Sohar, Oman

26/03/2024

Project No.: 0523286

The business of sustainability

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Appendix B - Stakeholder Engagement Plan

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CONTENTS

1 INTRODUCTION 1
1.1 Scope 1
1.2 Stakeholder Engagement Principles 1
1.3 Stakeholder Engagement Objectives 2
1.4 Structure of this SEP 3
2 PROJECT DESCRIPTION 4
2.1 Project Overview 4
2.2 Project Location 5
2.3 Employment & Labour 6
2.3.1 Construction Phase 6
2.3.2 Operation Phase 6
2.4 Project Schedule and Activities 6
3 POLICY, LEGAL AND ADMINISTRATION FRAMEWORK 7
3.1 Omani Regulations 7
3.2 TOTALENERGIES Company Policies 7
3.2.1 General Overview 7
3.2.2 Stakeholder Engagement 8
3.2.3 Code of Conduct 9
3.2.4 Human Rights 9
3.3 International Standards 10
3.3.1 IFC Performance Standards 10
3.3.2 Equator Principles 12
4 BASELINE CONTEXT 14
4.1 Project Context 14
4.2 Area of Influence 15
4.3 Overview of the baseline context 17
5 STAKEHOLDER IDENTIFICATION AND ANALYSIS 19
5.1 Stakeholder Identification 19
5.2 Stakeholder Analysis 25
6 STAKEHOLDER ENGAGEMENT CONDUCTED TO DATE 26
6.1 Engagements with SIPC and other authorities 26
6.2 Baseline stakeholder engagement activities 26
6.2.1 Stakeholder Issues and Concerns 27
6.3 ESIA Disclosure and Consultations 31
7 ENGAGEMENT ACTION PLAN 39
7.1 Overview 39
7.2 Phase 0: Permitting & Preparation 41
7.2.1 Appointment of a Community Liaison Officer (CLO) 41
7.2.2 Post ESIA Disclosure Engagement 42
7.3 Phase 1: Site Preparation, Construction, Pre-commissioning and Commissioning 43
7.3.1 Site Presence and Regular Engagement with Stakeholders 43
7.3.2 Monitor Contractors 43
7.3.3 Maintain Stakeholder Register 43
7.3.4 Maintain Grievance Procedure 44
7.3.5 Engagements Related to Transition to Operations 44
7.4 Phase 2: Operations and Maintenance 44
7.4.1 Confirmed Stakeholder Engagement Management 44

7.4.2 Continuous Regular Engagement 44
7.4.3 Maintain Stakeholder register & Maintain Grievance Procedure 45
7.5 Phase 3: Decommissioning 45
7.6 Engagement Tools 45

8 ROLES AND RESPONSIBILITIES 47

9 COMMUNITY GRIEVANCE MECHANISM 49

9.1 Step 1: Receive 49
9.2 Step 2: Acknowledge 50
9.3 Step 3: Assess and Assign 50
9.4 Step 4: Investigate 50
9.5 Step 5: Propose 50
9.6 Step 6: Follow up and close out 50

10 MONITORING, EVALUATION AND REPORTING 51

10.1 Overview 51
10.2 Data Management 51
10.3 Internal Reporting 51
10.4 External Reporting 52
10.4.1 Stakeholder information reporting 52

ANNEX A LOG OF BASELINE STAKEHOLDER ENGAGEMENT ACTIVITIES CARRIED OUT UP TO DATE (FEBRUARY 2024)

ANNEX B MINUTES OF THE ESIA DISCLOSURE MEETINGS HELD IN JANUARY 2024

ANNEX C STAKEHOLDER ENGAGEMENT LOG

ANNEX D SAMPLE OF GRIEVANCE COMMUNICATION FORM

ANNEX E GRIEVANCE LOG TEMPLATE

List of Tables

Table 1-1 Objectives of the Project Stakeholder Engagement Plan 2
Table 3-1 Other Relevant IFC Performance Standards 12
Table 5-1 Stakeholder Category List 20
Table 6-1 Main stakeholder issues and concerns (2019) 28
Table 6-2 Overview of ESIA disclosure meetings held in January 2024 33
Table 6-3 Overview of the key feedback received during the ESIA disclosure phase held in January 2024 36
Table 7-1 Stakeholder Engagement Tools 46
Table 8-1 SEP Roles and Responsibilities 47

List of Figures

Figure 2-1 Project site and surrounding infrastructure 5
Figure 4-1 Project Area of Influence 16
Figure 6-1 Public announcement in Al Shabiba newspaper on 11 December 2023 31
Figure 6-2 Public announcement in Al Shabiba newspaper on 4 January 2024 32
Figure 6-3 View of the ESIA package available in the office of the Governor of North Al Batinah 33
Figure 7-1 Stakeholder Engagement Programme Objectives 40
Figure 9-1 Community Grievance Mechanism Process 49

Acronyms and Abbreviations

Name	Description
AoI	Area of Influence
BID	Background Information Document
CLO	Community Liaison Officer
CSR	Corporate Social Responsibility
DG	Directorate General
E&S	Environmental and Social
EA	Environment Authority
EBS	Environmental baseline surveys
EHS	Environmental, Health, and Safety
EP	Equator Principles
EPAP	Equator Principles Action Plan
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
5OES	Five Oceans Environmental Services LLC
FEED	Front end engineering design
FGDs	Focus Group Discussions
GCC	Gulf Cooperation Council
GHG	Greenhouse Gas
HSES	Health, Safety, Environment and Social
IFC	International Finance Corporation
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
KIIs	Key Informant Interviews
LNG	Liquefied Natural Gas
MECA	Ministry of Environment and Climate Affairs
MISC	Majis Industrial Services Company
NTS	Non-technical summary
OCN	Other country nationals
OTEC	Oman Electricity Transmission Company
PS	Performance Standard
QRA	Quantitative Risk Analysis
RD	Royal Decree
ROP	Royal Omani Police
SBS	Social baseline survey
SEP	Stakeholder Engagement Plan
SP	Social Performance

Name	Description
SFZ	Sohar Free Zone
SIPC	Sohar Industrial Port Company
SWI	Seawater Intake
WBG	World Bank Group
UN	United Nations

1 INTRODUCTION

MARSA Liquefied Natural Gas LLC (referred to as MARSA LNG LLC hereafter or the "Company") is the proponent for the MARSA Liquefied Natural Gas (LNG) Bunkering Project in the Sultanate of Oman (hereafter the Project). Marsa Liquefied Natural Gas LLC is the proponent (Project owner), a single integrated company owned by TotalEnergies EP Oman Development B.V. (80% equity) and Almuzn Liquified Natural Gas LLC (OQ) (20% equity). The Project is located in the Governorate of Northern Al Batinah in Oman, between the Wilayas of Liwa to the north and Sohar to the south. The Project is being developed in compliance with MARSA LNG LLC's corporate standards and in line with Omani legislation, International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability and good international industry practice. The SEP is a living document and is updated as needed, including at various phases throughout the Project's lifecycle.

1.1 Scope

The purpose of this document is to establish a stakeholder engagement strategy and associated Stakeholder Engagement Plan (SEP). This SEP has been developed to give guidance to MARSA LNG LLC and its EPC contractors to meet the expectations of the Company, regulators, and the communities. The SEP describes the stakeholder identification process and outlines an engagement program to promote meaningful, timely, and effective engagement with stakeholders throughout the lifecycle of the Project.

This SEP provides the following:

- Description of national regulations and internal company requirements as well as applicable international standards;
- Identification and prioritisation of relevant stakeholders;
- Baseline context and stakeholder engagement conducted to date;
- Proposed approach to the engagement plan with stakeholders;
- Resources and responsibilities for implementing stakeholder engagement activities;
- Description of the community grievance mechanism; and
- Description of how stakeholder engagement activities will be incorporated into the Company's overall management system.

1.2 Stakeholder Engagement Principles

MARSA LNG LLC understands that effective stakeholder engagement and public consultation is a cornerstone of successful Project development and is committed to the engagement with stakeholders throughout the Project lifecycle. MARSA LNG LLC and its EPC Contractors will apply the following key guiding principles for stakeholder engagement on this Project which are based on MARSA LNG LLC's Stakeholder Relationship Management approach:

- To be open and transparent with stakeholders.
- To be accountable and willing to accept responsibility as a corporate citizen and to account for any potential impacts associated with Project activities.
- To have a relationship with stakeholders that is based on listening and dialogue as main pillars, as well as trust and a mutual commitment to an appropriate form of engagement.
- To respect stakeholders' interests, opinions and aspirations and ensure safe participation.
- To work collaboratively and cooperatively with stakeholders to find solutions that meet common interests and boost effectiveness.

- To be responsive and to coherently respond in good time to stakeholders.
- To be pro-active and to act in anticipation of the need for information or potential issues.
- To engage with stakeholders such that they feel they are treated fairly, and their issues and concerns are afforded fair consideration based on equal human rights.
- To be accessible and within reach of stakeholders so that they feel heard and to provide comprehensive information.
- To be inclusive and proactively anticipate, identify and include all stakeholders.

1.3 Stakeholder Engagement Objectives

The main objectives of the development and implementation of the SEP for the Project are outlined in below.

Table 1-1 Objectives of the Project Stakeholder Engagement Plan

Objective	Rationale
Identify relevant stakeholders for this Project.	Identify and categorise individuals or organisations that may be affected by the Project or have an effect on how the Project is implemented, noting that this is an ongoing process which many change throughout the life of the Project.
Distribute accurate Project information in an open and transparent manner.	Ensure that stakeholders, particularly those directly affected by the proposed Project, have all relevant information available to them to enable them to make informed comments and plan for the future. This helps reduce levels of uncertainty and anxiety. Information should allow affected parties to develop an understanding of potential impacts, risks and benefits and an open and transparent approach is central to achieving this aim.
Form partnerships to promote constructive interaction between all parties.	Develop relationships of trust between the Project and stakeholders to contribute to proactive interactions and avoid where possible, unnecessary conflicts based on rumour and misinformation. Identifying structures and processes to deal with conflicts and grievances allows the Project a better understanding of stakeholder concerns and expectations thereby providing opportunities to increase the Project's value to local stakeholders.
Record and address public concerns, issues and suggestions.	Document stakeholder issues, concerns and comments to allow the rationale for Project decisions to be traced and understood. Records also assist during review and audits of the Project in identifying thematic issues which may need a more holistic response, and during follow up engagements with the affected people. This approach also addresses potential concerns that stakeholder engagement is a token gesture by the developer that meets requirements but that it is not taken seriously in Project planning.
Manage stakeholders' expectations.	Expectations, both positive and negative, may not be aligned with the realities of the Project. Ensuring that expectations are kept at realistic levels (e.g., around job opportunities) limits disappointments and frustrations of directly-affected parties at later stages of Project implementation, and therefore mitigates the potential for conflict with stakeholders.
Fulfil Omani requirements as well as MARSA LNG LLC's and international standards.	Ensuring compliance can prevent potential Project delays based on procedural issues rather than substantive ones, and save the Company from any additional costs from fines.

1.4 Structure of this SEP

The document is structured as follows:

- *Section 1: Introduction*
- *Section 2: Project Description*
- *Section 3: Policy, Legal and Administration Framework*
- *Section 4: Baseline Context*
- *Section 5: Stakeholder Identification and Analysis*
- *Section 6: Stakeholder Engagement conducted to date*
- *Section 7: Engagement Action Plan*
- *Section 8: Roles and Responsibilities*
- *Section 9: Community Grievance Mechanism*
- *Section 10: Monitoring, Evaluation and Reporting*

2 PROJECT DESCRIPTION

2.1 Project Overview

The LNG Bunkering Project (i.e., the Project) consists of an onshore plant treating quality gas to produce Liquefied Natural Gas (LNG), primarily dedicated to LNG bunkering activities but also to carriers loading at the Sohar Port in Oman. The LNG plant will be built on reclaimed land protected by an embankment and leased by the Sohar Industrial Port Company (SIPC).

From a design perspective, the main project concept has been selected and the Front-End Engineering Design (FEED) has been done to develop the Project concept.

The Project will consist in the following main elements, which are presented in more details in Section 3.3.1 *Project Description* of the Environmental and Social Impact Assessment (ESIA):

- **LNG Plant:** consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to liquefy the Natural Gas inlet and produce LNG.
- **Condensate Export Pipeline:** comprising a short pipeline (<1km) that will supply condensate (a by-product of the LNG Plant production) to ADVARIO's tank farm (former Oil Taking Terminal (OTT)) for future use by another industry within the Sohar Port (i.e., OQ Refineries and Petroleum Industries LLC - OQRPI). Outside of MARSA LNG LLC's fence, the condensate export pipeline will cross an existing pipeline corridor within the port to reach the tank farm fence which is located approximately 100 m from the fence. Around 10 m of the pipeline may be buried, and the rest will be above ground on the existing/upgraded pipe rack. While the pipeline construction, tie-in to ADVARIO's tank farm and commissioning will be completed by an EPC Contractor of MARSA LNG, the operation and maintenance of the pipeline will be the responsibility of MARSA LNG.
- **Electrical Transmission Line:** comprising an approximately 3.5 km-long buried electrical cable that will connect the LNG substation with the existing Substation operated by Oman Electricity Transmission Company (OETC) within the Sohar Port. The installation, termination and connection between the two substations will be undertaken by MARSA LNG LLC's EPC Contractor. Operation and maintenance of the LNG substation as well as the underground transmission line will be the responsibility of MARSA LNG.
- **Topside of the LNG Export Jetty**: the jetty subsea foundation and access road will be designed and built by SIPC and is outside the Project's scope. However, the jetty topsides (operational area) will be completed by MARSA LNG LLC's EPC Contractor and is part of the Project' scope. The topside elements required for loading include a pipe rack, process manifolds, LNG loading arms, safety measures, and a jetty control station. The operation of the jetty topsides is within the Project' scope, while the substructure maintenance, ship movements and mooring operations remain within SIPC's scope of work.

In addition, the following associated facilities[1] are considered for the Project:

- An extension to the **OQGN feed gas pipeline**: the existing OQGN network will be extended by approximately 2.5km, to feed the LNG Plant with natural gas up to a Receiver Station operated by OQGN nearby the LNG Plant. The pipeline extension will be buried and will run within an existing pipeline corridor within the port. The construction, operation and maintenance of the pipeline will be performed by OQ GN and is not part of the Project's scope;
- The **marine component of the Jetty**: the subsea part of the Jetty will be designed and built by SIPC and is not part of the Project's scope. As base case, it will be around 450-500 m long and equipped with a 4-m wide road. On the other hand, the jetty topsides (operational area) will be completed by the MARSA LNG LLC's EPC Contractor and is part of the Project' scope.

1 Associated Facilities (AFs) to the Project are facilities (i.e. infrastructure developments) that are not funded by the Project and that would not have been constructed or expanded if the Project did not exist, and without which the Project would not be viable.

- A **solar plant** is planned to be constructed on a separate plot to supply power to the LNG Plant during operation. The solar plant will be connected to the grid network and from there, energy will be procured for the LNG Plant. The LNG plant will consume around 44% of the energy produced by the Solar Plant during the day through power wheeling agreements with OETC for usage of their grid network for power supply. Nighttime electricity will be procured from the OETC Grid through the same dedicated power connection. Since the Solar plant will be producing the entire energy needs of the LNG plant during the day itself, there will be an excess of around 56% during the day which will be sold on the Omani spot market. The solar plant is not part of the Project's scope, and it will be evaluated in a separate and dedicated ESIA. However, considering that it is built as an offset GHG Scope 2 emission solution for the Project, the potential cumulative impacts associated to the construction and operation of the solar plant have been assessed as part of the Project's impact assessment.

2.2 Project Location

The Project will be located in the Sohar Industrial Port, situated approximately 220 km northwest of Oman's capital city of Muscat. The Project site is located just outside the Strait of Hormuz. Sohar Port is in a favourable location for trade and cargo handling in and out of the Arabian Gulf, and on a major shipping route between Europe and Asia.

The Project site is located in a port expansion area already reclaimed and leased by SIPC (Figure 2-1) The reclaimed land was part of the Sohar Port Reclamation Project managed by SIPC and is located between the existing harbour breakwater and Majis Industrial Services Company S.A.O.C. (MISC) Seawater Intake (SWI). On the other hand, the jetty subsea structure construction will be managed by SIPC and is not part of the Project' scope.

The LNG site will occupy only a part of the future reclaimed land, as shown in Figure 2-1.

Source: 50ES, 2023.

Figure 2-1 Project site and surrounding infrastructure

2.3 Employment & Labour

2.3.1 Construction Phase

At present, a maximum number of 1,800 workers is expected on site during the peak of activity, working 10 hours per day with overtime of 2 hours for some sections. Work will be implemented on a rotation or shift system basis.

The workforce will consist of at least 30% Omani workers (national) while the rest will be other country nationals (OCN).

Internationally recognised worker conditions, health, safety and environment standards for workers will be applied. These will include full-time doctors and paramedics employed to provide 24-hour medical cover by direct presence or on call.

2.3.2 Operation Phase

At present, the predicted average number of personnel during the entire operation phase is approximately 120 people. The work regime in operation phase will be on a resident basis and a limited number of staff will be on shift basis.

2.4 Project Schedule and Activities

The Project will include the following phases:

- *Construction, pre-commissioning and commissioning phase (Phase 1)*: *Construction, pre-commissioning and commissioning phase (Phase 1): includes civil works, construction of buildings and installation of temporary site facilities, as well as mechanical and electrical works. The LNG Plant construction activities are planned to take approximately 34 months including pre-commissioning and commissioning phases. Currently it is foreseen that the main construction activities will start in the third quarter of 2024 and will be concluded with the start-up of the plant in mid-2027. The commissioning phase will last 15 months and will start by the first quarter of 2026.*
- *Operations and maintenance phase (Phase 2):* From the LNG plant start-up, the operation will commence and involve periodic maintenance activities at the Project site facilities and associated infrastructure. The design life of the LNG plant is of 25 years.
- *Decommissioning phase (Phase 3)*: At the end of the planned operational lifetime, the operation of the Project facilities and associated infrastructure will be reviewed and either extended or decommissioned. Decommissioning will involve the removal and reuse / recycling / disposal of surface structures and the reinstatement and restoration of the affected sites.

3 POLICY, LEGAL AND ADMINISTRATION FRAMEWORK

3.1 Omani Regulations

Omani requirements regarding stakeholder engagement include:

- The Royal Decree (RD) 114 relative to the Conservation of the Environment and the Prevention of Pollution (supersedes RD10/82) requires an EIA to be conducted for the Project in order to identify potential environmental and social impacts and define mitigation measures.
- The Omani legislation does not establish any legal requirements regarding Stakeholder Engagement. The only guidance is provided through Environmental Authority (EA) Guidelines. According to EA Guidelines:

  - The Guideline on Environmental Impact Assessment mentions that "*The proponent in consultation with the Ministry should determine who is interested in the project, what their concerns are, and how the concerned parties should be involved in the EIA […]*"

  - It also indicates the importance of "*Public information*" and the importance of an "*open and balanced EIA Process*". Ultimately, the extent of engagement is to be agreed with the regulator or the ministry in charge of the project.
- It should be noted that the SIPC is requiring IFC's Performance Standards (PS) and Integrated Pollution Prevention and Control (IPPC) standards be applied to the Project in order to be compliant. However, the full extent of the implementation of IFC's is not clearly defined.

3.2 TOTALENERGIES Company Policies

3.2.1 General Overview

TotalEnergies is committed to comply with applicable Omani environmental and social regulatory requirements as well as TotalEnergies's internal standards in line with applicable international standards and best practice, specifically:

- TotalEnergies Standards
  - Social Baseline Study (GS EP SDV 101)
  - Social Impact Assessment (GS EP SDV 102)
  - Human Rights Impact Assessment (HRIA) (GS EP SDV 103)
  - Environmental impact assessment of E&P activities (GS EP ENV 120)
  - Societal Directive (DIR GR SBS 001)
  - Stakeholder and Local Impact Assessment (CR-GR-HSE-412)
  - TotalEnergies's Code of Conduct
  - Human Rights Policy and related documents (HR's Briefing Paper Update (April 2018))
  - Environmental Requirements for projects design and E&P activities (GS EP ENV 001)
  - Environmental Baseline & Monitoring Studies: Onshore Sites (GS EP ENV 111)
  - Environmental Baseline & Monitoring Studies: Offshore & Coastal Waters (GS EP ENV 112)
  - GIS Deliverables for HSE (GS-GR-HSE-412)
- World Bank Group (WBG) Standards
  - IFC Performance Standards (2012) on Environmental and Social Sustainability (IFC PS 1, 2, 4, 5 and 8 in particular).

- IFC/World Bank Environmental, Health, and Safety (EHS) General Guidelines (IFC, 2012);

- Other Applicable International Standards
  - United Nations Universal Declaration of Human Rights, 1948
  - UN Guiding Principles on Business and Human Rights
  - United Nations Declaration on Fundamental Principles and Rights at Work, 1998
  - IPIECA standard for Integrating human rights into environmental, social and health impact assessments
  - Voluntary Principles on Security and Human Rights
  - International Labour Organization
  - Equator Principles IV, 2020.

3.2.2 Stakeholder Engagement

Engagement with external stakeholders and communities is an integral requirement of MARSA LNG LLC's societal approach as set out in in the Societal Policy, Societal Directive and Company Rule, as mentioned above. As part of MARSA LNG LLC's societal commitment to create value for local communities, the Company aims to build constructive, sustainable relationships with stakeholders, whose support is seen as a key factor in the success of the Company's business. MARSA LNG LLC's community engagement approach is based on:

- Nurturing dialogue with its stakeholder including, authorities, business, civil society & local residents ;
- Managing the impact of the Company's operations by applying the mitigation hierarchy; and
- Contributing to local human, cultural and economic development.

The approach to stakeholder engagement for the Project is guided by the following principles. These are based on the above-mentioned TotalEnergies standards and policies applicable for community dialogue and adapted to the Project context.

- Establish and open, honest, transparent and fact-based communication throughout the project lifecycle: engage in regular and appropriate information disclosure; manage stakeholder expectations; clearly communicate on project benefits and risks; and focus engagement around the potential and actual negative impacts of concern to stakeholders;
- Ensure equitable access to dialogue and opportunities: encourage participation by being inclusive and accessible to stakeholders so that they feel able to participate on equal terms; ensure the dialogue reaches all groups within the population.
- Actively demonstrate that the Project listens to the population and addresses concerns in a coherent and fair manner: engage with stakeholders such that they feel they are treated fairly, and their issues and concerns are given fair consideration; listen to stakeholder concerns and take them seriously; provide responses as required; be responsive and coherently respond in good time to stakeholders.
- Communicate appropriately: communicate in a manner that is culturally appropriate, effective, and understandable to potentially-affected persons;
- Engage proactively: to be proactive and to act in anticipation of the need for information or potential issues.
- Ensure safe participation: safe participation for all stakeholders without fear of risk of retaliation or persecution.

3.2.3 Code of Conduct

TotalEnergies's commitments are in line with the Guiding Principles on Business and Human Rights adopted by the United Nations Human Rights Council in 2011, the key conventions of the International Labor Organisation (ILO) and the Voluntary Principles on Security and Human Rights.

In relation to their projects, TotalEnergies's commitments regarding the different stakeholders are defined as follows:

- Host countries: the environment and culture of the host countries is respected in line with their sovereignty.
- Local communities: the right of local communities is respected by identifying, preventing, and mitigating any impact on their environment and way of life and remedying the situation as needed. Dialogue is established as early as possible to foster lasting relationships with those communities, and we are mindful of opportunities for community development. Grievance procedures and corrective measures will be designed and implemented collecting particularly the views of vulnerable groups, including indigenous peoples.
- Suppliers: clear and fairly negotiated contracts are key for TotalEnergies. The relationship with suppliers and contractors is based on three cornerstones: dialogue, professionalism and meeting commitments.

3.2.4 Human Rights

The TotalEnergies Human Rights Strategic Roadmap integrates the respect for Human Rights into the risk and impact management processes, including but not limited to new country entry evaluations, acquisitions and divestitures procedures, environmental and social baselines and impact assessments, purchasing systems, etc.

TotalEnergies's Human Rights Guide identifies three important Human Rights issues related to the risks and impacts of the Project's operations:

- Human rights in the workplace, considering not only TotalEnergies employees but also suppliers' and contractors' staff, as well as business partners and their subcontractors. TotalEnergies takes into consideration the employee's working conditions, respect for private life, discrimination-free environment and health and safety safeguards, irrespective of the political and social context or any complexities found in the countries of operation. There is a strict prohibition on forced labour and child labour.
- Human rights and local communities, paying special attention to the rights of local communities, especially indigenous communities and its rights. The objectives are two-fold:
  - Establish dialogues with affected communities at a very early stage, and maintain constructive relationships with them and other stakeholders; and
  - Respect the rights of communities by identifying and addressing impacts, and where appropriate by providing remedy for adverse impacts that could not be avoided.

Human rights and security, involving protective measures taken against threats to both individuals and property. Correct management of human rights issues in line with the security of the projects ensures a better integration and respect of the local environments. Security management is based on risk identification and prevention, anticipating crises and reporting of incidents. Prevention of risks includes training and dialogue with all stakeholders.

3.3 International Standards

3.3.1 IFC Performance Standards

The International Finance Corporation Performance Standards (IFC PS) on Environmental and Social Sustainability are considered a benchmark for good practice for environmental and social risk management in private sector developments. The IFC PSs require that clients engage affected communities through disclosure of information, consultation, and informed participation, in a manner commensurate with the risks to and impacts of the Project on the affected communities.

The IFC PSs include specific guidance on conducting stakeholder engagement both during the planning phase and through the project lifecycle.

The mains standards that will be considered in the development of this SEP are:

- IFC Performance Standards (2012) on Environmental and Social Sustainability (IFC PS 1, 2, 4, 5 and 8 in particular).
- IFC/World Bank Environmental, Health, and Safety (EHS) General Guidelines (IFC, 2012).

Stakeholder engagement requirements are outlined in *PS1: Assessment and Management of Environmental and Social Risks and Impacts*. The key requirements for consultation and disclosure through the life of the project are summarised in Box 3.1.

Box 3.1 Outline of IFC Performance Standard 1

Stakeholder Analysis and Engagement Planning

Stakeholder engagement is an on-going process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and on-going reporting to Affected Stakeholders.

Disclosure of Relevant Project Information

Provide affected stakeholders with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such stakeholders and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Consultation

Consultation will be in line with the degree of impact of the Project and should: i) begin early and continue through project, ii) be based on prior disclosure of relevant and easily accessible information on the project, iii) focus engagement on those who are directly affected, iv) be free of outside interference and external manipulation, v) enable meaningful participation, vi) be documented.

Informed Consultation and Participation

For projects with potentially significant adverse impacts on affected stakeholders, conduct an informed consultation and participation process. It should involve deep exchange of views and information, and an organized and iterative consultation, leading to the project incorporating into their decision-making process the views of the affected stakeholders on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The process should be documented, in particular the measures taken to avoid or minimize risks to and adverse impacts on the affected stakeholders. The stakeholders should be informed about how their concerns have been considered.

External Communications

Implement and maintain a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track, and document responses, if any; and (iv) adjust the management program, as appropriate. In addition, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability.

Grievance Mechanism for Affected Stakeholders

Establish a grievance mechanism to receive and facilitate resolution of affected stakeholders' concerns and grievances about the client's environmental and social performance.

On-going Reporting to Affected Stakeholders

Provide periodic reports to the affected stakeholders that describe progress with implementation of the project Action Plans on issues that involve on-going risk to or impacts on affected stakeholders and on issues that the consultation process or grievance mechanism have identified as a concern to those stakeholders. The Performance Standards require that after completion of an environmental assessment the consultation and disclosure must continue throughout the life cycle of the project.

The IFC PSs also have stakeholder engagement and consultation requirements to manage specific impacts as described in the following PSs and presented in more detail in Table 3-1:

Table 3-1 Other Relevant IFC Performance Standards

Standard	Key Components
PS1: Assessment and Management of Environmental and Social Risks and Impact	Underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders.
PS2: Labour and Working Conditions	Recognises that the pursuit of economic growth through employment creation and income generation should be balanced with the protection of basic rights for workers. Acknowledges that constructive worker-management relationship and safe and healthy working conditions may enhance the efficiency and productivity of operations. As such, requires engagement between projects and their workers including mechanisms for workers to report grievances.
PS4: Community Health, Safety & Security	Recognizes that project activities, equipment and infrastructure bring benefits to communities including employment, services and opportunities for economic development. However, the project can also increase the potential for community exposure to risks from development. Where project activities pose risks of adverse impacts on the health, safety and security of affected communities the developer is required to make available relevant information (including the details of an Action Plan), in an appropriate form, to affected parties and government authorities so that they can fully understand the nature and extent of the risks.
PS8: Cultural Heritage	Recognises the importance of cultural heritage for current and future generations and is consistent with the convention concerning the protection of the world's cultural and natural heritage. Where sites of cultural heritage are potentially impacted by the project the developer will consult with local communities as well as relevant national authorities responsible for the maintenance of such sites.

Note: PS5 on Land Acquisition and Involuntary Resettlement is not relevant for this Project.

3.3.2 Equator Principles

The Project is being developed in accordance with financing requirements, including the Equator Principles (EP) which are intended to serve as a common baseline and framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects. The EPs have been updated and the next version, EP4, has become effective for all mandated transactions as of July 2020. Some of the notable modifications of the EP4 include: an expansion in the scope of financial products to which it applies, an expansion in the application of E&S Assessment and an expansion in the application of international E&S standards.

The Statement of Principles of the EP4 includes specific guidance on conducting stakeholder engagement both during the planning phase and through the project lifecycle.

The mains principles that have been considered in the development of this SEP are:

- Principle 5 "Stakeholder Engagement": demonstrate effective Stakeholder Engagement, as an ongoing process in a structured and culturally appropriate manner, with Affected Communities, Workers or other Stakeholders. An Informed Consultation and Participation process will be conducted in the case of potentially significant adverse impacts on Affected Communities.

- Principle 6 “Grievance Mechanism”: establish as part of the ESMS an effective grievance mechanism, designed for use by Affected Communities and Workers to receive and facilitate resolution of concerns and grievances about the Project’s environmental and social performance.

4 BASELINE CONTEXT

4.1 Project Context

ERM was awarded to perform an ESIA related to the project Sohar LNG Bunkering in 2019. The contract was signed in November 2019 with associated schedule implying total duration of 7 months (from 24th September 2019 to 24th March 2020).

As the project progressed, it was understood that the level of project definition available to meet project schedule (e.g., project description cut-off point was planned by January 2020) was insufficient to fully meet scope for Lender requirements, and to some point Sohar Industrial Port Company (SIPC) requirements (as per their comments to the scoping report). This led to a period of 4 months in which project data was deeply discussed, collaborations were made, and assumptions were discussed and agreed. In May 2020 remaining gaps were acknowledged through the progress calls and progress reports, and TotalEnergies expressed its desire to proceed with finalization of the ESIA and project process. It was agreed that the ESIA would be a full report aligned with required standards as far as feasible using a combination of available design information and key design assumptions based on typical industry practice in order to form a basis to assess likely potential impacts. Recognizing the potential limitations of this approach, remaining gaps associated to lack of data or TotalEnergies decisions would need to be filled in at a later stage, as a form of variation and through annexes and follow up work. This included things like atmospheric emissions and noise modelling, climate change and accidental events. See Progress report for April and May 2020 for further details on known gaps.

On this basis, ERM produced all the draft chapters of the ESIA. Drafts were sent to TotalEnergies between January 2020 (e.g. Legal Framework) and June 2020 (impact assessments and ESMP) including EBS and SBS (based on field activities). Comments received were processed and a Final Draft was submitted in June 2020, with the objective to plan disclosure activities and finalize the work in September.

In this period, TOTAL's project timelines changed due to several reasons including project design, COVID etc. Between July and September 2020, project activities were mostly on hold while waiting for TotalEnergies' comments to the Final Draft. Only limited project management activities took place (four progress calls to catch up on review status), and ESIA consultation planning.

Between October 2020 and February 2021, ERM submitted two revised versions of the ESIA: one after TotalEnergies' review (ESIA Final A) and one after SIPC's review (ESIA Final B). The Project was officially put on hold on in March 2021.

On the 2nd of February 2023, a call was held with TotalEnergies where TotalEnergies presented the status of the MARSA LNG project and the changes in the project. Among the changes in the project are:

- The project's location has been moved to another plot which is an existing reclaimed land within the industrial area of Sohar. The size of the reclaimed land itself is smaller than the original plot.
- With the change of location, the layout of the plant (which will now occupy 44.5 ha of the reclaimed land area) has changed. A FEED update is planned with the same 3 competitors in March 2023 to determine: LNG Plant processes and LNG Tank, Underground networks, accesses and interconnections, Administration area, so called Operating Support Area (OSA), Interfaces (Connection points at B/L, electrical cable routing, feed gas pipeline, Condensate export, drainages and accesses to the Plant and Jetty) and LNG Jetty general arrangements. Other items that need to be revisited are: soil improvements requirements, safety studies, jetty topsides engineering inputs and GHG reduction opportunities. TotalEnergies informed that, while the QRAs will be revisited, the level of risk will remain exactly the same as the Basis of Design/criteria for such safety studies will not change.
- A solar plant is planned to be constructed in a different plot as an offset solution as it will compensate Scope 2 GHG emissions of the LNG plant

Therefore, the ESIA version B including this SEP were amended to reflect changes indicated above.

4.2 Area of Influence

For the purpose of this SEP, the Project Area of Influence (AoI) focuses on the Project site and the surrounding area where potential direct impacts are expected to occur. The social AoI has been defined to include a total of 12 villages or settlements located within a 2-Km radius of the Port, although focus has been placed primarily on those villages that may be more directly affected by the development due to their proximity, namely Majis, Ghadafan, Al Khuwairiyah and Falaj al Qaba'il. Changes occurred in the Project description, particularly in terms of Project location in 2023, are not deemed to affect the Project AoI which remains the same as defined in 2019 and is presented in Figure 4-1 below.

Figure 4-1 Project Area of Influence

4.3 Overview of the baseline context

The socioeconomic context of the Project is dominated by the Sohar Free Zone (SFZ) and the Sohar Industrial Port. Established in 2002, the SFZ, together with the Port, has attracted over US$26 billion in investment to become one of the GCC's largest industrial zones (SIPC, 2019). The expansion of the Sohar Port and corresponding expansion of its free zone led to rapid development of the industrial sector, mainly petrochemicals and metals, and related socioeconomic change. Alongside the port and free zone expansion is a new airport expansion project, which will see an increase in both domestic and international capacity.

According to the 2023 Desktop Research (refer to Section 6.2.3 *Methodology* of the ESIA Report), the Sohar Industrial Port Area and its Freezone has experienced significant growth in all key areas. Land occupancy was 77% in 2022 and 14 new contracts were awarded[2]. By end of 2022, 52 countries were represented within the Freezone. According to the CEO of Sohar Port and Freezone, the Sohar is planned to become an integrated industrial, logistics and port complex and a regional hub for many of Oman's major national industries.

According to the 2023 Desktop Research, the population was estimated at 269,900 individuals in Sohar Wilayat, with approximately 64.60% male (above the national level of 62.10%) and 52.30% expats (also higher compared to the national average of approximately 41.90%).[3] In Liwa Wilayat, the population was 63,296 as of 1 January 2023 and was characterised by 63.90% male ((above the national share of male) and 39.60% expats (below the national average).[4] In both Wilayas, the population is fairly young as, for example, only about 3% of the population in Liwa is above 50 years old.

Prior to the construction of the Port, the entire area from the village of Harmul (Liwa Wilaya) in the north to Majis (Sohar Wilaya) in the south was an undeveloped rural area in which agriculture, cultivation of dates, livestock breeding, and fishing were the main economic activities.

The broader socioeconomic changes brought about by the development and recent expansion of the Port and associated industries include population changes in the surrounding communities with the increased presence of expatriate workers, potential changes in local culture and attitudes, as well as changes in the physical landscape and the general socioeconomic landscape of the area. In general, this has been caused by the marked shift from more traditional sectors, such as agriculture and fishing, towards industrial development.

Compared to 2010, population data available as of 1 January 2023 shows that the population in Liwa has increased approximately 4 times. This can be explained by the resettlement of people from Ghadafan village, whose settlement boundary is approximately 400 m from SIPC concession boundary, to 'Madinat al Ahlam' (the City of Dreams) in Liwa, located some 21 km northwest of the Port.

However, despite the decline in traditional livelihoods since the establishment of the Port and in the past 10 years, fishing in particular remains an important livelihood and a primary source of income for most of the population in the coastal villages of Harmul and Majis. Farming activities have been in decline due to groundwater salinity and increasing land value in the area, and agricultural activities in the area are mainly focused on animal husbandry, which is mostly a supplemental source of income. Farming has been mostly replaced with public sector jobs and limited jobs in the private sector. However, in some settlements such as Al Khuwairiya farming remains the primary livelihood for farmers who are now forced to rent agricultural land in less affected areas to cultivate.

Regarding the national and local economy, due to the country's traditional dependence on expatriate work force, in 1988 the government decided to enact the Omanisation Policy, consisting of boosting the Omani labour. The North Al Batinah Wilayat counts on high literacy rates (95%) but low rates of employment in mid-high level positions as well as low rates of employment among youth. Based on

[2] Sohar Port and Freezone announces impressive growth in all key areas - Times of Oman, accessed on 25 July 2023

[3] eCensus Portal, accessed on 29 July 2023

[4] eCensus Portal, accessed on 29 July 2023

discussions with sheikhs and community members (i.e. fishermen and farmers), locals from the area are most commonly employed as drivers or technicians (scaffolders, smelters, welders, electricians, plumbers, etc.).

With regards to health conditions, the community's perception[5] is that air quality degradation attributed to industrial activities in the Port has contributed to increasing incidences of asthma and respiratory illnesses and allergies. Main health infrastructure in the area includes public health centres in Falaj Al Qabail and Hallat al Sheikh as well as three private clinics. Additional private clinics and the Sohar hospital are located further away.

[5] Community perception gathered during the baseline stakeholder engagement activities carried out up to date (May 2020), described in Section 5.

5 STAKEHOLDER IDENTIFICATION AND ANALYSIS

Stakeholders include individuals or groups that may influence or be impacted by the Project, described as follows:

> *A stakeholder is any person, group of persons, or organization on which the Project (or activity) has an actual or potential, direct or indirect, positive or negative impact, or one that has an actual or potential, direct or indirect, positive or negative impact on the Project (or activity).*

The level of interest and impact of any given group of stakeholders is dependent on a number of factors including level of authority, socio-economic context, influence, education and cultural factors.

5.1 Stakeholder Identification

Stakeholder identification began at Project inception and planning and has continued through the various stages of the Project development.

Stakeholders identified to date represent the organisations and individuals who may be directly or indirectly (positively or negatively) affected by the Project or who may have an effect on how the Project is implemented.

Stakeholders identified to date for inclusion in engagement activities meet one of the following criteria:

- have an interest in the Project;
- would potentially be impacted by or have an influence on the Project (negatively or positively); or
- could provide commentary on issues and concerns related to the Project.

Identified stakeholders can be summarized as follows:

- *Primary Stakeholders*: Those directly affected by the Project such as fishermen, farm workers and nearby neighbours to Project site, including members of the public and various institutions.
- *Secondary Stakeholders*: Those indirectly affected by the Project but who will influence the Project implementation. These include the responsible agencies, government ministries, municipal and communal authorities and traditional leaders (sheikhs).
- *Key stakeholders: These* are people or groups who might belong to neither of the first two groups, who can have a positive or negative effect on an effort, or who are important within or to an organization, agency, or institution engaged in an effort.

Stakeholders were categorised, based on their various needs, interests, and potential influence on the Project as outlined in Table 5-1.

Table 5-1 Stakeholder Category List

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
Central Government Authorities (Ministries in Muscat and/or their Regional Offices)	Central Government is of primary political importance to the Project in terms of establishing policy, granting permits or other approvals, and monitoring and enforcing compliance with Omani Law throughout all stages of the Project life-cycle.	■ Ministries and Directorate General offices of relevant Ministries: - Environmental Authority (EA) - Ministry of Labour - Ministry of Transport, Communications and Information Technology - Ministry of Social Development (MoSD) - Ministry of Agriculture, Fisheries and Water Resources (MAFWR) - Ministry of Health - Ministry of Heritage and Tourism - Ministry of Education - Ministry of Housing and Urban Planning - Ministry of Justice and Legal Affairs - Directorate General (DG) offices of Ministries. ■ Civil Defence and Ambulance Authority (PACD)
Governorate and Local Government Authorities	The Governorate and Local Government (Majlis Al Shura and Wali) are of importance to the Project as they are responsible for implementation of legislation, and development plans and policies at the Governorate/Wilayat level. The Majlis Al Shura constitute the Consultative Assembly of the Central Government of Oman. The Consultative Assembly has 83 elected members (Shura Members) drawn from Oman’s 59 Wilayats.	■ Wali of Liwa ■ Wali of Sohar ■ Council Representatives ■ Majlis Al Shura Representatives

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
	The Walis are designated by the Central Government (Ministry of Interior) and are the head of the Sheiks. There is one Wali per Wilayat (district of a Governorate). They are key leadership figures at local level.	■ Governor of North Al Batinah Governorate (note: the Wali of Sohar is the acting Governor at the time of writing). ■ Sohar Local Municipality (previously known as Sohar Development office, reporting to the Diwan of Royal Court) ■ Liwa Local Municipality
Local Community Representatives (Sheiks)	The Sheiks are elected local community leaders acting as representatives of their local community (at settlement level). Elected sheikhs are likely to be from the dominant tribe within the community. They are key leadership figures at local level.	■ Sheikhs of settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghuzzayyil, Al Hadd, Wadi Al Qasab, Uqdat Al Mawani, Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul.
Public company	SIPC is the Project's main stakeholder to engage with, in terms of granting the ESIA approval, and coordinating level of engagement during the Project lifecycle.	■ Sohar Industrial Port Company (SIPC)
Local Institutions (Public services)	Local public services including educational, health and law enforcement related stakeholders that potentially may be directly or indirectly affected by the Project activities or the Project's associated social and environmental impacts.	■ Government health centres ■ Law enforcement: Royal Oman Police ■ Law enforcement: Royal Omani Police (Traffic Department) ■ Law enforcement: Royal Oman Police (Coastal Guard) ■ Law enforcement: Royal Oman Police (Customs and Immigration) ■ Public educational centres ■ Prosecutor office in Sohar and Liwa

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
International agencies	Organizations with direct interest in the Project, and its social and environmental aspects, and that are able to influence the Project directly or through public opinion. Such organisations may also have useful data and insight and may potentially become partners to the Project in areas of common interest such as the implementation of community investment or CSR projects if applicable.	■ International agencies with offices in Muscat: UNICEF, WHO, FAO, UNFPA
Civil society	Organizations with direct interest in the Project, and its social and environmental aspects, and that are able to influence the Project directly or through public opinion. Such organisations may also have useful data and insight and may potentially become partners to the Project in areas of common interest such as the implementation of community investment or CSR projects if applicable.	■ General Federation of Oman Trade Unions ■ Human Rights Commission Office ■ Jusoor - CSR Organization Sohar ■ Environment Society of Oman ■ Omani Women's Association Sohar ■ Omani Women's Association Liwa ■ Indian Social Club Sohar ■ Sohar Sports Club ■ Omani Network of Fishing Hobbyists Sohar ■ Takafol Sohar ■ Hassad Liwa
Businesses	Private sector industries and companies that may be affected directly or indirectly affected by the proposed Project and its activities. The businesses Vale, Sohar Aluminium and OQRPI are also tenants of the Sohar Port.	■ Vale ■ Sohar Aluminium ■ OQRPI ■ Oman Society for Petroleum Services (OPAL) ■ JSRS (Joint Supplier Registration System)

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
		▪ Private health clinics ▪ Private educational centres ▪ Port Contractors (e.g. Al Bahwan Group)
Potentially affected communities/groups	Communities may be directly or indirectly affected by the proposed Project and its activities. These communities need to be made aware of the Project's schedule and its planned activities as well as of the potential benefits that will come in the form of employment and Community Investment or CSR if applicable.	▪ Fishermen in Majis, Liwa, Harmul ▪ Farm owners in Majis, Khuweiriyyah and Falaj Al Qabail ▪ Communities living in the settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghazzayyil, Al Hadd, Wadi Al Qasab, Uqdat Al Mawani, Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul. ▪ Expatriate workers

Vulnerable groups	Vulnerable groups may be affected by the Project by virtue of their social or economic standing, limited education, lack of employment or access to land.	▪ Vulnerable groups living in the settlements in the AoI: Majis, Al Khuwairiyah, Falaj al Qaba'il, Ghadafan, Al Ghazzayyil, Al Hadd, Wadi Al Qasab, Uqdat Al Mawani, Al Mukhaylif, Liwa, Hallat Al Sheikh and Harmul:
		  ▪ Very poor households
		  ▪ Women and Female-headed households
		  ▪ Unemployed youth
		  ▪ Elderly and orphans
		  ▪ Disabled persons
		  ▪ Children

Stakeholder Categories & Groups	Connection to the Project	Stakeholders
Academia and Education institutions	Education institutions and individuals with direct interest in the Project, and its social and environmental aspects and that are able to influence the Project directly or through public opinion. Such organizations may also have useful data and insight and may be able to become partners to the Project in areas of common interest. Potential partners' interests lie in the provision of services and supplies to the Project.	■ National Training Institute (National Office with a branch in Sohar) ■ Danna Training Services (Local) ■ International Maritime College (Local) ■ Sohar University (Local)
Media	Local, regional and national level media will typically have a higher level of influence over the Project and may be leveraged to influence local stakeholders' perceptions of the Project.	■ Media: Arabic and English newspapers

5.2 Stakeholder Analysis

Once identified, stakeholders are assessed based on their anticipated degree and topics of interest, as well as their role in processes which may affect activities. Their feedback is then analysed to understand their key issues, comments and concerns about the Project.

To support the analysis of stakeholders and help develop an appropriate approach for engagement, the following additional information was recorded for the identified stakeholders:

- Influence on the Project (high, medium, low); and
- Interest in and impact on the Project (high, medium, low).

Influence refers to the power that the stakeholders have in relation to decisions either taken by, or affecting the Project. This power may be in the form of stakeholders that have formal control over the decision-making process or it can be informal in the sense of protesting against, blocking or allowing Project operations to continue.

It is also important to map those stakeholders whose interests determine them as stakeholders, i.e., may be directly involved with the Project or have something to either gain or lose because of Project implementation. Understanding stakeholder level of interest can help clarify the motivations of different actors and the ways in which they might be able to influence the Project.

Impact refers to the consequences for the stakeholder of undertaking the Project in relation to their environment, socio-economic and cultural context. The level of impact also influences affected stakeholder's interest in the Project; the higher the level of impact, the higher the interest in the way impacts are being addressed.

Different levels of engagements will be proposed for different categories of stakeholders. This is primarily based on experience with similar projects and the analysis of the stakeholder consultation and engagement process to date. Less intensive forms of engagement such as disseminating information may be adequate to keeping stakeholders informed about Project progress. However, solving the more systemic and deep-rooted challenges or major changes in Project activities requires more collaborative engagement.

6 STAKEHOLDER ENGAGEMENT CONDUCTED TO DATE

The engagement activities carried out to date at the time of writing (May 2020) include engagements as part of the ESIA approval process (scoping related engagements as well as Project disclosure engagement with SIPC) and social baseline data collection for the Social Baseline Study (SBS) report (completed in April 2020).

The results of the engagement activities carried out to date have been taken into consideration in this SEP, feeding into MARSA LNG LLC's understanding of the baseline conditions, stakeholder interests and concerns and subsequently guiding the proposed approach to engagement during the ESIA process and throughout the Project activities.

6.1 Engagements with SIPC and other authorities

The following engagements held to date with SIPC and other relevant authorities are listed below:

- Kick-off meeting with SIPC (24th September 2019);
- Meeting with SIPC to present the Project's initial stakeholder engagement plan (10th October 2019);
- Meeting with SIPC regarding the air quality modelling held in Sohar (9th January 2020);
- Meeting with SIPC to present Scoping Report held in Sohar (22nd January 2020);
- Meeting with Ministry of Environment and Climate Affairs (MECA, now the Environment Authority) to discuss on air quality data availability and monitoring held (February 2020); and
- Meeting with SIPC and representatives of Port of Rotterdam to review the comments received from SIPC to the scoping report and align their expectations on the contents of the ESIA, Safety package and QRA (4th March 2020).
- Virtual meeting with SIPC on 31st July 2023 to present updates in the Project description as well as the proposed approach for the disclosure of the ESIA report following 2023 updates.
- Virtual meetings with SIPC on 3rd October 2023, 25 October 2023 and 15 November 2023 to present progress on the process of updating ESIA version B to version C and coordinate on the permitting and ESIA disclosure processes.

6.2 Baseline stakeholder engagement activities

Engagement as part of the ESIA process was conducted during a 9-day field survey from 27th to 31st October and 3rd to 6th November 2019 and was led by a combined 5OES/ERM team.

The purpose of the field survey was:

- To collect specific socioeconomic, health, and human rights data at the local level to the extent available and at the Wilaya level; and
- To establish initial contact with key stakeholders in Muscat and Sohar and introduce the Project.

The data collection process was guided by the key issues and information gaps identified during the desktop review process and described in the Bibliographic Baseline Study prior to the field survey. Data collection stakeholder engagement activities consisted primarily in Focus Group Discussions (FGDs), Key Informant Interviews (KIIs) and settlement profiling activities. This process was primarily qualitative in nature.

The primary objectives of the baseline stakeholder engagement activities were to:

- Briefly present the Project to stakeholders;

- Collect socioeconomic and health information at the settlement level to the extent available and at Wilayat level in order to collect more detailed information on specific issues identified during the scoping desktop review; and
- Document stakeholder opinions, questions, concerns and expectations to assist in defining the terms of reference and inform the scope of the ESIA.

As part of the engagement process, two separate meetings were held with the Walis of Liwa and of Sohar and other local government representatives to disclose basic Project information and collect feedback on the Project and request baseline data. Additionally, over 35 meetings with key governmental and non-governmental stakeholders at the national, regional and local levels were also organised.

Meetings held in Muscat during that same timeframe focused on national level stakeholders and included central ministry offices and relevant non-governmental organizations, while data collection activities in Sohar focused on regional and local level stakeholders, including regional ministry offices, local government representatives, local community members and associations, expatriate worker representatives, and relevant public and private institutions.

National level data collection efforts continued after the field survey. Specifically, follow-up data requests were sent to the points of contact at the relevant ministries to collect more quantitative data on specific aspects. However, it should be noted that at the time of writing, most of these requests were not answered and some data gaps still remain. National level data collection is expected to continue until the submission of the Environmental and Social Impact Assessment (ESIA) report through follow up information requests and clarifications as required.

At a local level, the baseline stakeholder engagement activities were conducted as individual meetings with relevant local government ministry representatives (i.e. DG of Labour for Al Batinah North, Regional Office of Agriculture, Fisheries and Water Resources, Sohar Municipality, etc.), groups of non-governmental stakeholders (i.e. business associations, fishermen representatives, women's associations, etc.), and community members (i.e. fishermen and farmers).

At the start of every meeting, a high-level introduction about the Project and the ESIA process was provided as a means to inform stakeholders It was followed by a discussion on various topics, including but not limited to: community health, infrastructure and public services, livelihoods (agriculture and fishing), employment, worker issues, gender issues, cultural change, health and education, recommendations and opinions from those stakeholders met and a review of the follow-up data collection actions agreed.

See Annex A for details on the baseline stakeholder engagement activities carried out (date, participants and objectives of each meeting).

6.2.1 Stakeholder Issues and Concerns

Stakeholders indicated that their main concerns were related to the Project's impacts, benefits of the Project (employment) and recommended that engagement with stakeholders be continuous throughout the Project's lifecycle.

Table 6-1 below captures the main key issues raised and recommendations offered by stakeholders during the 2019 baseline stakeholder engagement activities.

Table 6-1 Main stakeholder issues and concerns (2019)

Topic	Issues and Concerns
Employment and Local economy	▪ Repeated concerns regarding access to employment opportunities for population from the local area (i.e., AoI settlements and the Wilayat of Sohar and Liwa) and for more than lower-level positions. Specialized skills are available in the local communities and people with specialized education should receive priority for employment opportunities. ▪ When companies externalise their recruitment to contractors and subcontractors during construction, the local content element is often lost with limited employment opportunities for locals from the area, especially for higher level positions. This contributes to increasing frustration on the part of the local population. ▪ Companies should give priority to people from local areas even if training is required, before expanding recruitment to the national level. Compliance with Omanisation policy requirements should be a minimum. It is recommended to employ at least 30% of Omani employees from the Wilayat. ▪ Importance of providing specialized training opportunities, especially to degree holders or individuals with general education levels, to allow them to benefit from employment opportunities for higher level and more stable positions. ▪ It is perceived that vocational trainings conducted by other organizations/businesses have not benefited women in the community as they do not offer training for positions in which women can be employed and they do not guarantee employment. ▪ Vocational trainings are also needed to support local entrepreneurship and Small and Medium sized Enterprises (SMEs) for both genders (finance, accounting, etc.). ▪ Opportunities for local SMEs is needed. Oman LNG in Sur cited as benchmark project for support to local SMEs. Recommendation that MARSA LNG LLC's follows the same targets for tendering to local SMEs (i.e., 10% of the tenders). ▪ Concerns regarding the short-term nature of employment opportunities during construction phases. Recommendation to develop a strategy to reintegrate Omani employees previously employed by contractors from other projects into the Project's operation phase. ▪ Companies in the Port should support local farmers by buying local produce from the local markets in Liwa and Sohar. ▪ Fishing communities have limited opportunities for employment due to limited education levels. It is important to train and educate youth from fishing communities to allow them to gradually transition to industrial sector jobs and benefit from employment opportunities. ▪ It is perceived that a combination of factors including loss of fishing grounds and access to sea, environmental pollution, and overfishing have contributed to the decline in fisheries over time. However, the establishment of the Port and industrial activities within the Port are viewed by fishermen as the main causes of loss of fishing grounds and pollution. ▪ Concerns regarding impacts of the land reclamation and Port extension on fishing activities.

Topic	Issues and Concerns
Community Cohesion	■ Mixed feedback about the pros and cons of the presence of expatriate workforce in the settlements. Main benefit is related to the creation of new sources of income through accommodation rentals by locals, whereas drawbacks have to do with hygiene in unauthorised farms, community safety and cultural differences. ■ Increase in population of expatriate workers in local settlements should be gradual and controlled so as to avoid increase to social services and disruption to community cohesion. ■ In response to concerns from locals regarding the presence of expatriate workers in unauthorised farms, the authorities advocate for camps to be established in properly planned and designated areas in the SFZ to avoid such issues.
Environment and Health	■ Repeated concerns relating to potential Project impacts, including air quality impacts related to processing of the gas, increase in cumulative emissions, etc. Community perception is that air quality degradation due to industrial activities in the Port has contributed to increased incidences of asthma and respiratory illnesses and allergies in local communities. ■ Perceived lack of transparency and distrust by communities and sheikhs towards the Port and the Ministry of Environment regarding the standards and measures in place to regulate air emissions. Lack of trust also regarding how of community health is evolving. ■ Waste management was cited as a major concern regarding the Project. ■ Perception that seawater temperatures have increased due to the outfall from industrial facilities which contribute to decreasing fish stocks. ■ Agricultural lands in coastal areas of Al Batinah are relatively easily re-registered for other uses because many farms are old, small and not profitable which is exacerbated by rising groundwater salinity and reduced land productivity.
Community investment	■ The Project is expected to consider Oman LNG in Sur as a benchmark project for good CSR and local employment practice and for MARSA LNG LLC's to follow the same targets for CSR investment (i.e. 1 to 1.5% of revenue). ■ Recommendation to assign a percentage of revenues and royalties to social projects benefiting local communities. ■ Direct support to the local communities is necessary, especially communities closer to the coast and to vulnerable groups, to balance out some of the perceived negative environmental impacts of the Port operations affecting neighbouring communities (i.e., air pollution, smells, seawater pollution, groundwater salinity, etc.). Relevant suggestions were made by Sheikhs, community members, and regional ministry offices.

Topic	Issues and Concerns
Stakeholder Engagement	▪ Recommendation that engagement with local communities, Sheiks, and the Walis should continue after the start of construction and throughout the Project's lifecycle. ▪ Recommendation to establish a Committee with community and government representatives from each Wilaya through the Wali's office to facilitate communication and participation in the Project.

6.3 ESIA Disclosure and Consultations

The final ESIA Report (version C), as updated in 2023, in English language along with a Non-Technical Summary in Arabic language, was made available to stakeholders and general public for a period of 39 calendar days (from 11 December 2023 to 18 January 2024). The disclosure was facilitated through electronic access via a link [https://totalenergies.com/oman/marsa-lng-project-environmental-and-social-impact-assessment-esia], accessible through a QR code, as well as through hardcopies. The availability of the ESIA report for public consultation was announced through two announcements posted in the Al Shabiba newspaper, in Arabic language, as follows:

- Announcement on 11 December 2023 when hardcopies of the ESIA report and feedback forms were made available to the public, indicating where the ESIA was available for review and soliciting feedback – see Figure 6-1 below.

Figure 6-1 Public announcement in Al Shabiba newspaper on 11 December 2023

دعوة عامة لتقديم التعليقات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى للغاز الطبيعي المسال

تدعو شركة مرسى للغاز الطبيعي المسال ش م م عامة الناس لتقديم التعليقات والملاحظات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى لتزويد السفن بالغاز الطبيعي المسال.

تعتزم شركة مرسى للغاز الطبيعي المسال، وهي شركة مشتركة بين توتال إنرجيز وشركة المزن للغاز الطبيعي المسال ش م م (التابعة بالكامل لمجموعة او كيو) (OQ)، تطوير محطة للغاز الطبيعي المسال في منطقة ميناء صحار الصناعي. ستقوم المحطة بتوفير الغاز المسال كوقود للسفن البحرية. وكجزء من عملية الحصول على تصريح بيئي، تم إعداد دراسة تقييم بيئي واجتماعي لتقديمها إلى الجهات العمانية المختصة.

تماشيًا مع أفضل الممارسات الدولية، يسعى المشروع إلى الحصول على تعليقات وملاحظات حول نتائج دراسة التقييم من جميع أصحاب العلاقة من الحكومة وعامة الناس. لذلك يُدعى الجمهور للاطلاع على التقرير البيئي والاجتماعي وتقديم تعليقاتهم وملاحظاتهم.

ستمتد فترة الإفصاح لمدة ثلاثين (٣٠) يومًا ابتداءً من ١١ ديسمبر ٢٠٢٣ إلى ١١ يناير ٢٠٢٤. خلال هذه الفترة، سيتم وضع نسخة واحدة من تقرير التقييم البيئي والاجتماعي، ونسخ متعددة من الملخص غير التقني، واستمارات التعليق في ثلاثة مواقع، وهي مكتب محافظ شمال الباطنة، ووالي صحار، ووالي لوى ، متاحة لعامة الناس.

يمكنكم الاطلاع على تقرير التقييم البيئي والاجتماعي الشامل على موقع https://totalenergies.com/oman ، أو عن طريق مسح رمز الـ QR. يمكنكم أيضا تقديم التعليقات باستخدام عنوان البريد الإلكتروني للمشروع esia.grm@totalenergies.com

شاكرين لكم حسن تعاونكم ومشاركتكم.

Source: 5OES, December 2024

- Announcement on 4 January 2024 refreshing information about the ESIA availability for public review and soliciting feedback – see Figure 6-2 below.

Figure 6-2 Public announcement in Al Shabiba newspaper on 4 January 2024

دعوة عامة لتقديم التعليقات حول دراسة التقييم البيئي والاجتماعي لمشروع مرسى للغاز الطبيعي المسال

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بدأت فترة الإفصاح في تاريخ ١١ ديسمبر وستمتد لمدة ثلاثين (٣٠) يومًا وستنتهي في تاريخ ١٨ يناير ٢٠٢٤. خلال هذه الفترة، سيتم وضع نسخة واحدة من تقرير التقييم البيئي والاجتماعي، ونسخ متعددة من الملخص غير التقني، واستمارات التعليق في ثلاثة مواقع، وهي مكتب محافظ شمال الباطنة، ووالي صحار، ووالي لوى ، متاحة لعامة الناس.

يمكنكم الاطلاع على تقرير التقييم البيئي والاجتماعي الشامل على موقع

https://totalenergies.com/oman ، أو عن طريق مسح رمز الـ QR. يمكنكم أيضا تقديم التعليقات باستخدام عنوان البريد الإلكتروني للمشروع
esia.grm@totalenergies.com

شاكرين لكم حسن تعاونكم ومشاركتكم.

Source: 5OES, January 2024

In addition to the disclosure in electronic form, one hardcopy of the ESIA Report (version C) in English, ten hardcopies copies of the NTS in Arabic, fifty hardcopies of the feedback form in Arabic, a sheet displaying the QR code for electronic access to the ESIA, a poster to attract attention and indicate the availability of materials, a box of fifty ballpoint pens, and a feedback collection box were made available at each of the following locations:

- Office of the Governor of North Al Batinah located at North Al Batinah Governor Office, Al Bahja St, Al Hambar, Sohar, P.O. Box: 341, Postal Code: 311;
- Wali Office in Liwa GHG6+V85; and
- Wali Office in Sohar located at P.O. Box: 261, Postal Code: 311, 9Q72+42Q, Sohar.

This ensured that stakeholders with limited digital literacy also had the opportunity to learn about the Project and provide feedback. The documents were placed in areas overseen by the institutional security to prevent damage or unauthorized removal of the materials.

Figure 6-3 View of the ESIA package available in the office of the Governor of North Al Batinah

Source: 5OES, December 2023

Additional means which were made available to stakeholders to provide feedback on the ESIA included:

- Using feedback forms which were available to participants in the disclosure meetings.
- Calling or sending WhatsApp messages to the phone number: 00968 9200 8157, during the entire ESIA disclosure period;
- Electronic communication, via email at esia.grm@totalenergies.com, during the entire ESIA disclosure period.

Anonymous feedback was also accepted.

In addition to making the ESIA available for public review, the disclosure meetings presented in Table 6-2 below as well as listed in Annex A were held:

Table 6-2 Overview of ESIA disclosure meetings held in January 2024

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
Monday, 8th January 2024					
11:00 – 12:30	Omani Women Association building, Liwa	Informal meeting	Omani Women's Association – Liwa	15 (all women)	Meeting attended exclusively by women

Date and time	Venue	Type of engagement	Stakeholders attending	Total number of participants / out of whom women	Notes
13:00 – 15:00	Lathaeth Sohar, Sohar	Informal meeting	Youth/ Charity Groups of Sohar and Liwa	5 (no women)	
18:30 – 20:00	Omani Women Association building, Sohar	Informal meeting	■ Omani Women's Association – Sohar	2 (all women)	Meeting attended exclusively by women
20:30 – 22:00	AL-Moazzeb Jordanian, Sohar	Informal meeting	Fishermen community of Sohar and Liwa	5 (no women)	Meeting organised after the 'Isha prayer (Islamic prayer) and to allow for people to travel to the venue
Tuesday, 9th January 2024					
08:30 – 10:30	Wali's office, Liwa	Formal meeting	■ Wali of Liwa, ■ Representatives of the Majlis Ashura ■ Representatives of Liwa municipal council ■ Sheikhs of communities in the Project's area of influence	9 (no women)	
11:30 – 13:30	Majan Hall, Sohar	Formal meeting	■ Deputy Wali of Sohar, ■ Representatives of the Majlis Ashura ■ Regional offices of concerned ministries: Environmental Department of North Al Batinah Government, Head of Labour Affairs North Al Batinah, Head General of Health Services North Al Batinah ■ Sheikhs of communities in the Project's area of influence	11 (no women)	

Source: ERM and 5OES, January 2024

The above-mentioned disclosure meetings intended to present the Project, the results of the impact assessment and defined mitigation measures as well as the Project's Grievance Mechanism to governmental stakeholders as well as non-governmental stakeholders, using a PowerPoint presentation and a Non-Technical Summary (NTS) in Arabic. They allowed collecting feedback, comments, concerns and recommendations from stakeholders on the Project's potential impacts and proposed mitigation measures. The meetings were also used to feedback to stakeholders on how their concerns gathered during the baseline stakeholder engagement carried out in 2019 have been taken into account for the development of the SBS report and informed the scope of the ESIA.

During the disclosure process, a total of seven written feedback forms were received, out of which two in Liwa and five in Sohar. Additional feedback was received through Whatsapp and included two employment applications. No feedback was received via email or phone.

Table 6-3 below presents an overview of the key feedback received during the ESIA disclosure meetings held in January 2024 and indicates how this was considered in the final version of the ESIA (version D). Detailed minutes of the disclosure meetings held are provided in Annex B to this SEP.

No actual grievances were received in relation to the Project during the ESIA phase.

Table 6-3 Overview of the key feedback received during the ESIA disclosure phase held in January 2024

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
Employment	Stakeholders in all meetings mentioned their expectations that the Project should prioritise employment local job seekers from the wilayats of Liwa and Sohar. Expectations also referred to access to long-term employment opportunities.	■ Wali Liwa office ■ Wali Sohar office ■ OWA, Liwa ■ OWA, Sohar ■ Charity Teams ■ Fishermen community ■ General public	■ Verbally during public disclosure meetings. ■ Written feedback forms.	Employment impacts are addressed in Section 8.6.1 of the ESIA. As a result of the ESIA disclosure, the enhancement measures for local economy and employment were supplemented with the following: 'To facilitate access to employment opportunities for local candidates (within the wilayats of Liwa and Sohar) with appropriate skill sets, a database of people looking for work will be maintained and will identify the candidates' place of origin'.
Environmental, Health and Social Impacts	Stakeholders shared concerns about the potential negative impacts of the Project such as the presence of flare and the potential impact of gas emissions on air quality, potential gas pipe leakage and the risk of explosions, or odour. Stakeholders also used the opportunity of the ESIA disclosure meetings to raise general concerns which were perceived to be attributable to the current industrial operations within the Sohar Industrial Port Area (SIPA). Examples included perceived increased incidence of health issues, such as cancer and miscarriages, reporting of deposition of white powdery residues on cars, trees, noise from industrial activities and operations including but not limited to jetty hammering and flaring, waste impacting local villages. The participants claimed that the industrial operations in the SIPA are adversely impacting fishing activities, particularly in Harmul, located approximately 200 meters from the port.	■ Fishermen community ■ Wali Liwa office ■ General public ■ OWA, Liwa	■ Verbally during public disclosure meetings. ■ Written feedback forms.	The Project's environmental impacts are addressed in Section 8.5 and relevant mitigation measures defined. As indicated in the ESIA Section 8.6.5.4, MARSA LNG LLC will: ■ communicate to affected stakeholders the progress on meeting the Project's environmental and socioeconomic commitments during the construction phase through, at a minimum the release of quarterly performance reports which will be posted on the Project website; ■ agree with government and other stakeholders the scope of third-party monitoring, which might involve local stakeholder representatives, in assessing whether social and environmental impact mitigation measures and other intended benefits are as effective as anticipated. The reports of the third-party monitoring will be made available to the public through MARSA LNG LLC website;

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
	There was a demand for increased transparency of the environmental monitoring results associated to industrial operations within the Sohar Industrial Port Area to local neighbouring communities.			■ involve affected stakeholders or third-party representatives in monitoring of the Project's socioeconomic and environmental performance for issues of great interest to the public. No changes were deemed necessary to the ESIA.
Project Social Investment and Responsibility	Social investment initiatives from Sohar port companies are perceived to be very small compared to the companies' revenue. Expectations in terms of access to benefits from the Project were raised by the majority of stakeholders who complained. Benefits should be directed to impacted villages around SIPA, particularly Harmul and Ghadhafan, without involving intermediaries or third parties. Requests were made for the Project to support the local community, including fishermen, sports clubs and charity teams as well as the OWA in Liwa and to prioritise partnerships with local SMEs.	■ Wali Sohar ■ Wali Liwa ■ Charity teams ■ OWA Liwa	■ Verbally during public disclosure meetings.	As indicated in the ESIA Section 8.6.5.4, a Social Investment Plan and Community Needs Assessment will be developed by MARSA LNG LLC in consultation with local communities, with active engagement required to determine the location and nature of investments. Relevant stakeholders will be kept informed on the progress of investment activities and opportunities. No changes were deemed necessary to the ESIA.
Stakeholder Engagement	Feedback from fishermen conveyed a sense of unfulfilled expectations and engagement fatigue. Grievances were expressed regarding the direct impacts of previous companies' operations within the SIPA, including issues such as noise from jetty hammering, cracks in the houses, and building damage. Requests were made to maintain the communities informed about the economic contributions of companies operating within the SIPA.	■ Fishermen ■ General public	■ Verbally during public disclosure meetings. ■ Written in feedback forms.	The Project will not result in additional restrictions to fishing or navigation and therefore no impacts on fishing livelihoods are expected. No changes were made to the ESIA. As indicated in the ESIA Section 8.6.5.4, quarterly project update leaflets will be prepared and widely distributed from six month prior to construction to the end of the construction phase. These information releases will emphasise the limited nature of employment and the recruitment processes and the inclusive nature and progress of the Social Investment Plan. No changes were deemed necessary to the ESIA.

Topic	Description of feedback	Stakeholders providing the feedback	Channel by which feedback was communicated	Reference to the ESIA sections where the topic /feedback is addressed including indication of any amendments made, as applicable
Grievance mechanism	Participants commented on the online feedback form, stating it cannot be instantly filled online and suggested that the process should be simplified. They recommended making the form more user-friendly, possibly allowing for real-time online submissions, to encourage more responses from the local community.	■ Charity teams	■ Verbally during public disclosure meeting.	No changes made to the ESIA; this feedback will be considered going forward by MARSA LNG LLC.

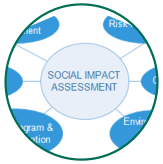
Source: ERM, February 2024

7 ENGAGEMENT ACTION PLAN

7.1 Overview

The stakeholder engagement programme is designed to cover all phases of the Project. The general objectives of stakeholder engagement under this SEP per Project phase are as outlined in Figure 7-1 below. Details regarding the type of engagement activities and stakeholders concerned are included in the remaining sections.

Figure 7-1 Stakeholder Engagement Programme Objectives



	Phase 0: Permitting and Preparation phase (ongoing)	Phase 1: Site Preparation, Construction, Pre-commissioning and Commissioning Estimated duration: a) Construction activities: 34 Months (starting Q3 2024 – concluding with the start-up of the plant in mid 2027) b) Commissioning phase: 15 Months (starting first quarter of 2026)	Phase 2: Operations and Maintenance Estimated duration: 25 years	Phase 3: Decommissioning
SEP Objectives	• Obtain licenses and permits (including ESIA approval) • Initiate actions to obtain the social license to operate the Project • Establish a Grievance Mechanism • Manage the recruitment process of local workforce	• Update stakeholders on Project progress • Address any grievances • Renew licenses and permits as required • Maintain the social license to operate the Project • Sustain peaceful working relationships with stakeholders	• Update stakeholders on Project progress • Address any grievances • Renew licenses and permits as required • Maintain the social license to operate the Project • Sustain peaceful working relationships with stakeholders • Manage the retrenchment process during transition from cons. to ops.	• Update stakeholders on decommissioning works and progress in schedule • Address Project decommissioning related grievances • Understand requirements from authorities • Manage the retrenchment process
SEP Activities	• Appointment of the CLO • Grievance procedure establishment • Disclosure of ESIA and Project activities to stakeholders • Engage around ESMP development	• Site presence of CLO and regular engagement Maintain grievance procedure • Maintain stakeholder register • Define and implement mutually agreed in-country value and social investment programs	• Site presence of CLO and regular engagement • Engagements related to transition from Phase 1 to Phase 2 • Maintain grievance procedure • Maintain stakeholder register Implement agreed social investment programs	• Site presence of CLO and regular engagement through engagement tools • Engagements related to retrenchment • Maintain grievance procedure • Maintain stakeholder register
Project Activities	• Project design and planning • Tendering • ESIA approval process • Permitting process	• Onshore facilities construction, jetty modifications, pipeline installation, transmission line and equipment and personnel mobilization.	• Operations of the LNG facilities, pipeline and transmission lines and associated facilities	• Hand over or Decommissioning of facilities • Reinstatement and restoration • Exit audits

Note: The social license to operate refers to the level of acceptance and (informal) approval by local stakeholders and communities where the Project operates. This does not consist in any formal permitting document.

Specific planning and engagement activities will be necessary at each Project phase; however, some activities will be ongoing throughout the entire Project cycle and therefore common to the different phases. Common activities include the following:

- Regular update of the Project Non-Technical Summary (NTS) as the Project moves forward and activities, schedules and milestones evolve.
- Regular update and revision of the stakeholder register including stakeholder analysis and re-evaluation as necessary throughout the different Project phases.
- Addressing comments, questions, and grievances regularly and through appropriate channels, and issuing information to stakeholders. This includes regular refreshers to stakeholders about the Grievance Mechanism and related processes.
- Regular information reporting to the different stakeholders as appropriate (see Section 10.4.1).
- Regular internal and external Project monitoring reports (in particular during Construction and Operations) (see Section 10.3 and Section 10.4).

7.2 Phase 0: Permitting & Preparation

During the Permitting and Preparation phase (Phase 0), the following stakeholder engagement activities are proposed as part of ESIA process. These involve the recommendation to appoint a Community Liaison Officer (CLO), the disclosure of the ESIA report and further engagement after the disclosure.

The implementation of the engagement activities proposed below will serve to ensure an effective engagement process going forward. The proposed engagement activities will also allow for the opportunity to explain to stakeholders how the Project is separate from other projects taking place or under development (such as the reclamation land project managed separately by SIPC) through continuous and accurate stakeholder engagement and communication on the Project.

7.2.1 Appointment of a Community Liaison Officer (CLO)

The Project will appoint a CLO to serve as interface between the Project and local stakeholders, including communities.

The CLO's role and responsibilities will include oversight of day-to-day community and stakeholder engagement activities and responsibility for interfacing between the stakeholders and the Project including its Contractors.

Final modalities for the appointment, line of reporting and role of the CLO following the permitting phase and based on the recommendation of the ESIA will be defined by the Project.

This person should be a neutral individual, ideally recruited from the local community, who speaks the dominant local languages, English and Arabic, and should be proven not to have a vested interest in a particular outcome.

This person will need to be acquainted with the stakeholders and stakeholder process as outlined in this SEP, including a clear understanding of the Project schedule and engagement milestones in order to inform stakeholders appropriately about the development of the Project. The CLO will have direct contact with SIPC and coordinate liaison activities. The EPC Contractor will also recruit a CLO.

The CLO will need to consider the grievance mechanism gender dynamics in the communication channels and to ensure that women and vulnerable groups are properly engaged and have a suitable recourse to voice complaints.

Details on the responsibilities of the MARSA LNG LLC's CLO and EPC Contractor CLO are provided in Section 8.

7.2.2 Post ESIA Disclosure Engagement

7.2.2.1 Engagement for Environmental and Social management plans development

After obtaining the environmental permit from EA, the environmental and social management plans, prepared as part of the Project's Environmental and Social Management System (ESMS) and described in Chapter 9 Framework Environmental and Social Management Plan of the ESIA, will have to be prepared. It is expected that additional engagement and consultation will be required to inform the development of the management plans.

Of particular importance will be the engagement to inform the development of the MARSA LNG LLC's in-country value strategy and plan and Omanization Management Plan, as government and stakeholder expectations in this regard are high.

7.2.2.2 Re-Engagement

Stakeholder engagement activities will have taken place during the ESIA process to consult relevant stakeholders at all levels and collect their feedback. Some follow-up engagement activities are also planned post-ESIA.

To formalise these engagements, within the SEP framework, and to ensure that all stakeholders have the same understanding, a round of refresher engagement meetings will be undertaken prior to the start of the Phase 1 activities. This will include the following:

- Formal engagements with national regulators, Wilaya, local authorities and community leadership to present the Project SEP and planned engagement activities over the coming phases of the Project as well as updated Project information.
- A community meeting(s) with representatives of communities in the AoI convened at an accessible location in Sohar/Liwa.

The approach to the refresher engagement meetings proposed will have to first be agreed with SIPC.

The agenda of the refresher engagement meetings shall include a Project update and information disclosure, using a presentation. This will cover:

- Updated Project information including the Project schedule and activities.
- The roles and responsibilities of the MARSA LNG LLC's CLO and the EPC CLO regarding engagements on the Project.
- Present the updated Project Stakeholder Engagement Plan.
- Continued dissemination of the Project Grievance Mechanism.

As with all engagement activities, these refresher engagement meetings shall be used as an opportunity to identify and register any new stakeholders and to gather and register stakeholder feedback, issues and concerns as well as feedback about the effectiveness of the Project Grievance Mechanism.

7.2.2.3 Disclosure of project Information and feedback collection

The NTS developed for ESIA disclosure meetings will be regularly updated to include additional information on Project development activities and shared with stakeholders during engagement activities.

The Project will also take advantage of engagement activities to collect comments, questions and grievances regularly through the grievance mechanism and directly through the MARSA LNG LLC's CLO and the EPC CLO.

7.3 Phase 1: Site Preparation, Construction, Pre-commissioning and Commissioning

7.3.1 Site Presence and Regular Engagement with Stakeholders

To ensure that the Project is accessible to all stakeholders, the EPC Contractor will have offices within the Project site. MARSA LNG LLC's CLO and the EPC CLO will be based on site, at an accessible location. Public notice board will also be displayed at agreed locations for example in the settlements of Majis, Ghadafan, Al Khuwairiyah and Falaj al Qaba'il[6], to guide any interested or affected parties who need more information or want to submit grievances.

The CLO will be responsible for implementing regular proactive and structured engagement with affected stakeholders throughout Phase 1.

Engagement during Phase 1 will be conducted at regular intervals, which will be defined based on the level of concerns and expectations of stakeholders. It will be focused on informing and updating stakeholders most notably community members (i.e., fishermen) about the Project site preparation, construction, pre-commissioning and commissioning activities and schedule. The regularity and the approach to the engagement proposed below will need to be first agreed with SIPC (who also carries out regular engagement with stakeholders for other purposes).

The engagement shall include:

- Face-to-face information dissemination, consultation, and coordination meetings with local leadership and other key authorities (e.g., coordination with coast guard).
- Focus Group Discussions for vulnerable and special interest groups with particular concerns such as fishermen, or community members in the AoI.
- Face-to-face coordination meetings with other tenants and projects in the area to manage construction impacts, in particular from road transportation and approaches to local employment.
- Information disclosure and consultation with local businesses, health and education institutions.

Information dissemination tools in addition to the public notice boards (e.g., NTS, flyers) will continue to be used to support the above activities.

7.3.2 Monitor Contractors

The contractors shall be required to support and participate, as relevant, in the implementation of the Project SEP throughout their contract period. MARSA LNG LLC will take the lead on stakeholder engagement and relationship management throughout the Project lifecycle to ensure that social risks are appropriately managed.

However, MARSA LNG LLC's CLO will liaise with and coordinate with the EPC CLO and EPC staff to ensure that any interaction taking place between contractor workforce and stakeholders is consistent with the standards, core principles and procedures for undertaking, recording and documenting stakeholder engagements, as is outlined in this SEP. The MARSA LNG LLC's CLO and EPC CLO responsibilities are described in more detail in Section 8.

7.3.3 Maintain Stakeholder Register

MARSA LNG LLC shall update and revise the stakeholder register regularly and ensure that stakeholder analysis and mapping is assessed and re-evaluated as necessary based on information revealed through interactions, engagement activities and grievance management.

Any new stakeholders in the Project AoI or stakeholders that develop an interest in or are potentially impacted by the Project due to unforeseen events shall be identified and analysed and strategies will

[6] Those villages that are potentially more directly affected by the development.

be developed for engaging them. The CLO will be responsible for providing to the MARSA LNG LLC's Project HSE Manager any feedback or information on new stakeholders or changing stakeholder issues/risks which arise through their stakeholder interactions.

7.3.4 Maintain Grievance Procedure

The CLO shall provide regular refreshers to stakeholders about the Grievance Mechanism and shall respond quickly and effectively to grievances raised in line with MARSA LNG LLC's set procedures and guidelines, and through regular engagement activities try and anticipate where stakeholder issues or concerns may arise.

The CLO will also be responsible for identifying, logging, and responding to all grievances or reporting and escalating more complex issues to management as appropriate. The Project's procedure for tracking and responding to stakeholder grievances is described in Section 9. Close coordination with SIPC regarding grievance management will be required as appropriate.

7.3.5 Engagements Related to Transition to Operations

It is anticipated that there will be significant retrenchment/ contract termination of a number of Project staff by the various Project contractors. Prior to the conclusion of the construction phase and the start of operations, the ESMS will be revised along with the SEP, which will be updated in order to manage the transition and ensure consistent and systematic information to all potentially affected persons on the impending changes. The agreed messages will be disseminated through the CLO to the stakeholders, in particular the potentially affected ones. The communications with potentially affected stakeholders should be carried out early during the Phase 1 to allay fears and uncertainty regarding the potentially affected stakeholders' contract termination.

7.4 Phase 2: Operations and Maintenance

The operations phase will have significantly reduced staffing numbers and anticipated to have reduced stakeholder issues. However, stakeholder engagement will still be conducted with the relevant Project stakeholders.

The following will be undertaken in this phase:

7.4.1 Confirmed Stakeholder Engagement Management

Typically, the operations phase will have less Project activities which result in significant impacts on the community and other stakeholders.

However, there is still a need to retain the stakeholder engagement program for continuity of engagement with the specific stakeholders who may be potentially affected during this phase (i.e., fishermen due to bunkering, Omani Trade Union, worker representatives) as well as with other relevant stakeholders through continuous regular engagement and through specific engagements related to the transition from Phase 1 to Phase 2 (see Section 7.3 and 7.4.2).

7.4.2 Continuous Regular Engagement

Engagements shall be continually undertaken during the operations phase. Regular direct engagements with the relevant stakeholders and, where required, Focus Group Discussions around specific issues or concerns will be the main engagement activities between the CLO and the potentially affected stakeholders.

These engagements will be aimed primarily at maintaining continuity of relationships, monitoring the effects of Project impacts on stakeholders and demonstrating a long-term organisational commitment to delivering on social and environmental mitigations or to resolving outstanding issues and grievances or to design, deploy, assess socio-economic projects. Of high importance will be the engagement in relation to delivery of benefits to the community though implementation of social investment initiatives as well as engagement with the Omani Trade Unions and worker representatives.

The timings of these engagements will be determined by the MARSA LNG LLC's HSES Manager or the nominated manager and MARSA LNG LLC's Project Manager, observing the nature and scale of operations at any given time.

7.4.3 Maintain Stakeholder register & Maintain Grievance Procedure

As discussed in Section 7.3.3 and 7.3.4, the CLO will keep, update and revise the register as often as necessary during the Project's operations. The CLO will also ensure that the grievance management measures provided in the Grievance Mechanism (see Section 9) are adhered to in this phase.

7.5 Phase 3: Decommissioning

Decommissioning will result in retrenchment of the workforce and a number of activities to remove Project infrastructure and rehabilitate the site / prepare it for future use. Stakeholders will need to be informed about these activities in advance and throughout the decommissioning process. The SEP will need to be updated to address these changes but will include the following:

- Revisit the stakeholder identification and analysis in light of the proposed decommissioning approach.
- Communicate with affected stakeholders early during Phase 2 to allay fears and uncertainty regarding the decommissioning process.
- Communicate with stakeholder on the exit strategy planned in particular on social aspects (i.e. Grievances, rehabilitation, socio-economic projects, employment...).
- Provide regular updates and progress reports to stakeholders.
- Consult with all affected stakeholders on transfer and management of assets and liabilities.
- Manage grievances through the formal grievance mechanism and ensure no pending grievance is left.

7.6 Engagement Tools

To achieve a consistent and effective stakeholder engagement programme, standardised tools need to be developed and reviewed by Project management for use in the engagements.

The tools outlined in table below will be key to stakeholder engagement in all phases of the Project, and the contents and messages shall be reviewed and approved prior to dissemination.

Table 7-1 Stakeholder Engagement Tools

Tool	Description
NTS	A Non-Technical Summary (NTS) will be developed in Arabic and English and distributed during the engagement activities. The NTS will provide a description of the proposed Project, the Project schedule the engagement programme and schedule, contact details for the CLO (MARSA LNG LLC's CLO and EPC Contractor CLO) and information on the grievance mechanism. As the Project progresses, this document will be reviewed and updated as often as necessary to ensure accuracy of information at any given time.
Notice Board	Notice boards will be erected at agreed locations, accessible to the communities, and updated on a regular basis. The notice board will serve as an information dissemination tool. For example, the Project will be able to display updates on the Project's progress, designated community liaison officer contact details, information on the grievance mechanism and recruitment updates if relevant. Project information should be available in Arabic and English as well as other languages of expat workers (i.e., Hindi, Urdu etc.). Wherever possible, maps or visual aids will be used to increase accessibility of the notices.
Focus Groups Discussions (FGD)	In an FGD, a semi- structured approach is used to conduct engagements with different stakeholder groups for example men and elders, and women with specific issues of concern. The questions explored and discussed can follow specific themes for example labour related issues, livelihoods, etc.
Stakeholder Register	The CLO will maintain a stakeholder register to update the list of Project stakeholders identified and their contact details. The stakeholder register developed is presented in Table 5-1.
Stakeholder Analysis and Mapping	The CLO will maintain the Stakeholder mapping tool and re-evaluate it as necessary based on information revealed through interactions, engagement activities and grievance management throughout the Project lifecycle. The CLO will coordinate a session at least once per year to map the Project's stakeholders by level of influence and level of interest. All departments will be involved in this exercise to obtain the Project Stakeholder mapping.
Stakeholder Engagement Log	The CLO will maintain a stakeholder engagement log to plan and track engagements related to the different ESMS Management Plans. An example template for development of such tool is presented in **Annex** C.
Grievance Communication Form and Database	The CLO will maintain a stakeholder grievance database to record and track grievances as well as resolution status. A grievance communication form template is presented in **Annex** D and a grievance log/database template is presented in **Annex** E.

8 ROLES AND RESPONSIBILITIES

Stakeholder engagement is a core element of MARSA LNG LLC's overall business and shall be managed with clearly defined objectives, lines of responsibility, accountability, and budgets. Core functions related to stakeholder engagement and an overview of associated responsibilities are provided in the following table.

Table 8-1 SEP Roles and Responsibilities

Role	Responsibility/Accountability
MARSA LNG LLC's Management	Responsibilities include: ▪ Ensure proper implementation and follow up of the SEP. ▪ Ensure that relevant Project's employees are informed and trained on the SEP. ▪ Ensure that a function in charge of Social Performance (SP) is nominated and an adequate structure is put in place to ensure efficient implementation of the SP strategy including the SEP. ▪ Provide resources to ensure that interests of stakeholders are represented and taken into consideration during all phases of the Project ▪ Ensure that there are sufficient available resources for achieving engagement activities. ▪ Monitor and review stakeholder engagement required to assess effectiveness and frequency of activities as well as implementation of associated actions/commitments that have been documented. ▪ Ensures the proper implementation and follow up of the grievance mechanism procedure. Involved in the resolution of complaints of high complexity, difficulty or priority.
MARSA LNG LLC's Health, Safety, Environment and Social Manager (HSES Manager) or other nominated Manager (i.e. SP Manager)	Reports to the MARSA LNG LLC's Management. Responsibilities include: ▪ Monitor the implementation of the stakeholder engagement plan: review the plan of the stakeholder engagement activities and ensure they are appropriately implemented. ▪ Monitor the implementation of the grievance mechanism: review the management the grievance mechanism and grievance resolution process, supervision of the logged grievances and other issues in a timely manner, in line with the grievance process, TotalEnergies standards and best practice principles. ▪ Be in permanent communication with the CLO to be informed about the grievances' resolution status.

Role	Responsibility/Accountability
	▪ Perform training and awareness sessions of employees and contractors on local community relations and SEP.
MARSA LNG LLC's Community Liaison Officer (CLO)	Reports to the MARSA LNG LLC's HSES Manager or other nominated manager. Responsibilities include: ▪ Plan and lead the stakeholder engagement activities and coordinate the results and actions to be taken. ▪ Manage and implement the grievance mechanism and grievance resolution process. ▪ Maintain regular contact with communities especially the potentially affected through regular community visits to monitor opinions and provide updates on Project activities and ensuring communication with vulnerable groups. ▪ Maintain updated the stakeholder register, mapping and the stakeholder engagement activities register and records. ▪ Produce stakeholder engagement monitoring reports and submit to the hierarchy. ▪ Liaise and coordinate activities with EPC CLO and staff to ensure they comply with the SEP.
EPC Contractors Community Liaison Officer (CLO)	Reports to the TotalEnergies CLO. Responsibilities include: ▪ Comply with requirements stated under this document and relevant Project Management System applicable to Contractors. ▪ Provide assistance to the MARSA LNG LLC's CLO to ensure compliance with this plan. ▪ Communicate concerns, questions or views to the MARSA LNG LLC's CLO on compliance or implementation of the SEP. ▪ Provide data related to SEP performance/monitoring as required. ▪ In coordination with MARSA LNG LLC's CLO, communication with the Project stakeholders including vulnerable groups and implementation of stakeholder engagement activities described in this SEP. ▪ In coordination with the MARSA LNG LLC's CLO, implement the grievance mechanism and grievance resolution process, including dissemination of information regarding the grievance process to ensure that it is widely understood among stakeholders.

9 COMMUNITY GRIEVANCE MECHANISM

The Community Grievance Mechanism enables any stakeholder to make a complaint or a suggestion about the way the Project is being implemented. Grievances may take the form of specific complaints for damages/injury, concerns about routine Project activities, or perceived incidents or impacts.

The purpose of the Community Grievance Mechanism is to implement a formalised process (identification, tracking and redress) to manage complaints/grievances from communities and other local stakeholders in a systematic and transparent manner that could potentially arise from the Project.

Figure 9-1 below shows the grievance mechanism process.

Source: TotalEnergies, 2020

Figure 9-1 Community Grievance Mechanism Process

9.1 Step 1: Receive

Stakeholders will be offered different communication channels for submitting a grievance including:

- Directly to the MARSA LNG LLC’s CLO by filling the dedicated Grievance form in the annex of the Grievance Management Procedure in force and submitted to one of the dedicated locations.
- Directly to the MARSA LNG LLC’s CLO or EPC CLO, during engagement activities.
- Using the phone number 0096892008157 and email address esia.grm@totalenergies.com.
- Indirectly through the appointed grievance coordinator within the EPC contractor in the course of their duties as well as through the local community representatives (Sheiks).
- Through other designated access points including a dedicated phone number and letters to the Project site office or contact form of the Project website.

These grievances may be in written form or verbal complaints and shall be treated with equal respect. The filing of grievances shall be made easy for communities with various levels of literacy and shall be accessible and culturally appropriate. The log will include details of the complaint (unless anonymous) and details of the grievance.

All grievances or complaints submitted by stakeholder and received by a MARSA LNG LLC's or EPC Contractor personnel shall be channelled to the CLO who will be responsible for logging the grievance. Where the CLO is able to resolve the grievance, they will proceed to do so. It is envisaged that many grievances will be able to be resolved quickly between the CLO and the complainant. The grievance management will be described in detail in the MARSA LNG LLC's Grievance Management Procedure. An NTS (or flyer) describing the Grievance Mechanism shall be disseminated to the communities prior to start any engagement activities.

9.2 Step 2: Acknowledge

MARSA LNG LLC shall acknowledge receipt of the complaint within a standardised time period (period to be defined in consideration of the particularities of the local context in the Grievance Management Plan) and explain to the complainant the process including timelines of the remaining steps in the procedure.

9.3 Step 3: Assess and Assign

All grievances will need to undergo some degree of screening and prioritisation.

9.4 Step 4: Investigate

The CLO will work with other responsible members of the Project team to investigate the grievance and identify additional information to clarify the situation and/or improve communication between the stakeholder and MARSA LNG LLC and corrective or preventive measures to properly address the grievance. If necessary, if the grievance relates to a given site or location, the community liaison team will organise a site inspection. Investigation phase shall be conducted in a collaborative & transparent manner with concerned grievant & stakeholders.

9.5 Step 5: Propose

The CLO will communicate the response, stipulate mutual commitments, and ask for the complainants' agreement. If the complainant is not satisfied with the resolution, or the outcome of the agreed corrective actions the response should be reviewed and if appropriate amended in light of any discussions or negotiations. Where appropriate, SIPC and the Wali's office will be involved in this step to resolve certain complaints (where their involvement is necessary or recommended).

If the complainant is still not satisfied with the resolution, or the outcome of the agreed corrective actions, they should be free to take their grievances to a dispute resolution mechanism outside of MARSA LNG LLC's grievance mechanism.

9.6 Step 6: Follow up and close out

Where the stakeholder is satisfied with the responses provided to their grievances, the specific grievances will be concluded by the CLO and the register updated to indicate as much. All correspondences will be filed, and the corrective actions clearly updated against the grievances.

MARSA LNG LLC will ensure that all grievances raised by all Project stakeholders are treated impartially, respectfully and confidentially.

10 MONITORING, EVALUATION AND REPORTING

10.1 Overview

In order to record activities and assess the effectiveness of this SEP and associated community dialogue activities, MARSA LNG LLC will implement a data management and monitoring process as outlined below.

In addition, this section includes mechanisms for reporting to external stakeholders as an integral step in building relationships with stakeholders and promoting understanding between MARSA LNG LLC' and its stakeholders.

10.2 Data Management

Stakeholder engagement activities will be documented and filed in order to track and refer to records when required and ensure delivery of commitments made to stakeholders. The following stakeholder community dialogue records and documentation will be used and maintained by MARSA LNG LLC:

- Stakeholder register: On-going updates to the stakeholder register, including key contacts and contact details (telephone number, email address etc.) as additional stakeholders are identified.
- Stakeholder engagement log: Used to store, analyse and report on stakeholder dialogue activities. It will be populated with details on information presented, audience questions, MARSA LNG LLC responses and actions, and meeting evaluation results, when appropriate. The database will also be used to track frequency of meetings over the life of the project.
- Commitments register: Used to keep track of the commitments made to various stakeholders.
- Meeting minute template: Used to collect meeting minutes to be filed within the stakeholder database.
- Grievance log: Used to record all grievances received, management actions and whether it has satisfactorily been closed out.

Records will be reviewed on a quarterly basis to ensure that information is being recorded accurately and information maintained. Commitments and actions recorded during community interaction activities will also be regularly reviewed to ensure they are taken forward.

10.3 Internal Reporting

The following internal reports will be developed:

- Red Flag Reports: Weekly or daily reports for urgent items or incidents of significant nature. These red flag reports will be prepared by the TotalEnergies CLO in collaboration with the EPC CLO and sent to the MARSA LNG LLC HSES Manager or nominated Manager in charge, which will take action and/or escalate if necessary.
- Quarterly Progress Reports: Internal quarterly progress reports will be prepared by the MARSA LNG LLC CLO in collaboration with the EPC CLO. These reports will summarise:
    - Engagement activities undertaken this far: stakeholders met, key topics discussed, main concerns and expectations, positioning towards Project activities;
    - Grievance mechanism: participation, main grievances received, progress summary (actions to be taken and status);
    - Social licence risks to the Project;
    - Limitations (e.g. resources, internal alignment); and
    - Priorities for next quarter.

These reports will be discussed at quarterly meetings involving the MARSA LNG LLC CLO, the hierarchy and representatives of the relevant departments. The progress reports will be circulated internally as required.

10.4 External Reporting

10.4.1 Stakeholder information reporting

Once consultation with stakeholders has taken place, stakeholders generally want to know which of their suggestions have been taken on board, what risk or impact mitigation measures will be put in place to address their concerns, and how, for example, projects impacts are being monitored.

It is recommended to keep track of commitments made (through the commitments register) and to communicate progress made against these commitments on a regular basis (for instance during regular meetings with the community representatives). The commitment register of the ESIA shall be the starting base.

ANNEX A LOG OF BASELINE STAKEHOLDER ENGAGEMENT ACTIVITIES CARRIED OUT UP TO DATE (FEBRUARY 2024)

Date	Stakeholders Engaged	Objective of Meetings
Project disclosure		
09.01.2024	▪ Wali of Liwa, ▪ Representatives of the Majlis Ashura ▪ Representatives of Liwa municipal council ▪ Sheikhs of communities in the Project's area of influence	▪ Present the Project, the results of the impact assessment and defined mitigation measures as well as the Project's Grievance Mechanism ▪ Feedback to stakeholders on how their concerns gathered during the baseline stakeholder engagement carried out in 2019 have been taken into account for the development of the SBS report and informed the scope of the ESIA ▪ Collect feedback, comments, concerns and recommendations from stakeholders on the Project's potential impacts and proposed mitigation measures
09.01.2024	▪ Deputy Wali of Sohar, ▪ Representatives of the Majlis Ashura ▪ Regional offices of concerned ministries: Environmental Department of North Al Batinah Government, Head of Labour Affairs North Al Batinah, Head General of Health Services North Al Batinah ▪ Sheikhs of communities in the Project's area of influence	
08.01.2024	Omani Women's Association – Liwa	
08.01.2024	Youth/ Charity Groups of Sohar and Liwa	
08.01.2024	Omani Women's Association – Sohar	
08.01.2024	Fishermen community of Sohar and Liwa	
03.10.2023, 25.10.2023 and 15.11.2023	SIPC, Environmental Manager and Governmental Affairs Manager	▪ Present updates on the process of updating ESIA version B to version C ▪ Discuss permitting process ▪ Coordinate arrangements for the ESIA disclosure and consultation meetings
31.07.2023	SIPC, Environmental Manager	▪ Present updated Project description and timeline ▪ Present approach for ESIA disclosure and consultation meetings ▪ Understand potential changes occurred in the socioeconomic context of the Social AoI
30.10.2019	Wali of Liwa Representative along with the Majlis Al Shura representative and municipality representative	▪ Disclose basic Project information and ESIA process to key governmental and community representatives ▪ Collect stakeholder feedback and information
31.10.2019	Wali of Sohar Representative along with the Majlis Al Shura representative and municipality representative	▪ Disclose basic Project information and ESIA process to key governmental and community representatives ▪ Collect stakeholder feedback and information

Date	Stakeholders Engaged	Objective of Meetings
Social baseline collection meetings		
28.10.2019	Ministry of Health Representative, Director of Public Health Services	▪ Basic Project information and background disclosure ▪ Qualitative information obtained. Follow up needed to request additional information including quantitative data.
28.10.2019	Ministry of Environment (MECA, now the Environment Authority) Permitting department official, and head of hazardous substances and chemicals department	▪ Basic Project information and background disclosure ▪ Qualitative information obtained. Follow up needed to request additional information including quantitative data.
28.10.2019	Founder of the Omani Network of Fishing hobbyists	▪ Key background information on fisheries sector and evolution.
29.10.2019	SIPC, CSR Representative	Alignment and coordination for setting up meetings for present week and following week.
29.10.2019	Regional Office of Ministry of Agriculture and Fisheries (now the Ministry of Agriculture, Fisheries and Water Resources), Fisheries section	▪ Basic Project information and background disclosure ▪ Very limited information obtained. Follow up needed to request additional information including quantitative data.
29.10.2019	Public Authority for Civil Defense	▪ Basic Project information and background disclosure ▪ General information obtained (follow up needed with SIPC department for oil spills and emergency response).
29.10.2019	DG for Manpower (now the DG of Labour) for Al Batinah North	▪ Basic Project information and background disclosure ▪ General qualitative information obtained. Follow up needed to request additional information including quantitative data (coordination through SIPC).
29.10.2019	Jusoor Director	▪ Basic Project information and background disclosure ▪ Detailed information on CSR strategy and focus areas based on identified community needs.
39.10.2019	DG Office of Health	▪ Basic Project information and background disclosure ▪ Very limited information obtained. Follow up needed to request additional information including quantitative data, but only raw data available which does not include number of incidences. Limited sharing of information expected.
30.10.2019	CSR representative	▪ Coordination for organization of remaining meetings ▪ Overview of SIPC CSR programs

Date	Stakeholders Engaged	Objective of Meetings
30.10.2019	Regional Environment Office	▪ Basic Project information and background disclosure ▪ General qualitative information obtained. Follow up needed to request additional information including quantitative data on air quality indicators (coordination through SIPC).
30.10.2019	Informal meeting with fishermen on the beach closest to the Port southern breakwater	▪ Collect specific information related to fishing activities and sources of income, etc.
31.10.2019	Women from Sohar Wilaya	▪ Collect specific information pertaining to women and gender aspects in the AOI and economic activities ▪ Collect information on respiratory related health issues and health care service
31.10.2019	Liwa Resettlement Project Manager, Technical Office of the Regional Office of the Ministry of Housing	▪ Basic Project information and background disclosure ▪ Collect specific information on resettlement project as well as general housing standards and land allocation.
03.11.2019	Sohar Municipality, Assistant Director	▪ High level Project introduction to key government representatives and collection of feedback/recommendations. ▪ Information collected on social infrastructure the wilaya of Sohar and land allocation for different land use types. No recent population statistics (refer to NCSI website). General comments about the implementation of the Sohar master plan.
03.11.2019	Regional Ministry of Municipalities and Water Resources for North and South al Batinah (DG of Ministry, head of groundwater, and head of food safety and security)	▪ High level Project introduction to key government representatives and collection of feedback/recommendations. ▪ Information collected on groundwater salinity challenges and measures as well as food safety and security issues.
03.11.2019	Sohar Aluminium, CSR representative	▪ Information collected on general recruitment practices, worker housing, local content and community relations.
03.11.2019	Informal meeting with fishermen in Harmul	▪ High level Project introduction. ▪ Collected specific information related to fishing activities and sources of income for fishermen in Harmul, as well as some insight regarding fishermen in Ghadfan and al Hadd. ▪ Collected additional information regarding resettlement from a community perspective. ▪ Collected information on general grievances and complaints related to industrial activities in the Port.

Date	Stakeholders Engaged	Objective of Meetings
04.11.2019	DG of Social Development	▪ High level Project introduction to key government representatives and collection of feedback/recommendations. ▪ Collected information on vulnerable population, social issues at wilaya level and support programs. ▪ Statistics on number of families receiving support may be obtained upon request.
04.11.2019	Sheiks from Majis, Al Khuwairiya and Falag al Qabael – settlement profiling	▪ High level Project introduction to local community representatives and collection of feedback/recommendations. ▪ Collected general settlement profile information (population estimates, number of expats, health and education infrastructure in the settlement, main economic activities, health issues, changes in quality of life, presence of expat workforce (pos or neg)
04.11.2019	Chairman of Indian social club (for the past 9.5 years) and Head of ENT department at public hospital of Sohar	▪ Collected high level information and insights on issues related to labour welfare for workers employed in Sohar Port (sponsorship issues, recruitment, grievances, housing, etc.)
04.11.2019	Villages drive through	▪ Took pictures of infrastructure, agricultural land, fishing activities, etc.
04.11.2019	Farmers and farm owners in al Khuwairiyah	▪ High level Project introduction ▪ Collected specific information related to land use, agricultural livelihoods and sources of income.
04.11.2019	Informal discussion with expatriate workers working for contractor of ORPIC (now OQRPI)	▪ Collected specific information on labour welfare issues (sponsorship issues, recruitment, grievances, housing, etc.) –
05.11.2019	Institute representatives and personnel	▪ Collected information related to the demand for training courses in the area, as well as employment opportunities for youth in the AoI.

Date	Stakeholders Engaged	Objective of Meetings
05.11.2019	Village drive through	▪ General observations and pictures
05.11.2019	Informal discussions with community members from Ghadfan, al Hadd and al Ghuzayyil – high level settlement profiling	▪ Collected general settlement profile information (population estimates, number of expats, health and education infrastructure in the settlement, changes in livelihoods, presence of expat workforce) ▪ General observations and pictures
05.11.2019	Khalid al Rissi, General Practitioner	▪ Collected high level information about the number of health centres in the wilaya of Liwa, increased demand/pressure on health services, and collaboration between health centres in the area. ▪ No statistics on health incidences / visits were provided, nor was any general information shared on the types of health issues the population faced - Referred back to the DG of health.
05.11.2019	Students attending the NTI (5-6 males and 5-6 females)	▪ Collected information regarding training opportunities and employment opportunities for youth in the area.
05.11.2019	Camp manager, Bahwan Contractor	▪ Collected specific information on recruitment, sponsorship, housing standards, infrastructure and services, health coverage, and worker grievance mechanism.
05.11.2019	DG of Agriculture for North al Batinah	▪ High level Project introduction to key government representatives and collection of feedback/recommendations. ▪ Collected general information on evolution of farming and animal herding and challenges.
06.11.2019	Head of Rural Development (women focus) (now the Regional office of the Ministry of Agriculture, Fisheries and Water Resources), Agriculture Section)	▪ High level Project introduction to key government representatives and collection of feedback/recommendations. ▪ Collect information on role of women in agriculture and land related livelihoods.
06.11.2019	Village drive through	▪ Took pictures of infrastructure, agricultural land, fishing activities, etc.
06.11.2019	Omani Women Association of Liwa (Head and women from Liwa settlements)	▪ Collected very high level information on gender roles in Liwa, education level, involvement in food processing, handicrafts, and health aspects etc.
06.11.2019	Ministry of Agriculture and Fisheries (now the Ministry of Agriculture, Fisheries and Water Resources)	▪ High level Project introduction to key government representatives and collection of feedback/recommendations.

Date	Stakeholders Engaged	Objective of Meetings
		▪ Collected information on agriculture and fisheries sector in Sohar and Liwa and evolution and challenges.
06.11.2019	SIPC emergency response department, Walid Al Siabi	▪ Collected information on emergency response plan and procedures in the Port.
06.11.2019	SIPC Transport department	▪ Collected information on marine traffic management, and management of incidents. ▪ Statistics on Port traffic (number and type of vessels) requested and will be provided next week.
06.11.2019	Village drive through	▪ Took pictures of infrastructure, agricultural land, fishing activities, etc.
07.11.2019	General Federation of Oman Trade Unions	▪ Collect general information on Labour issues in the industrial sector.
07.11.2019	UNFPA Representative programme manager	▪ Collect information on population change and gender matters and vulnerable groups.

ANNEX B MINUTES OF THE ESIA DISCLOSURE MEETINGS HELD IN JANUARY 2024

Minutes of Meeting

Project Title	MARSA LNG Bunkering Project	Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with the Omani Women Association (OWA) in Liwa	Location	OWA of Liwa, Liwa
Date	Monday, 8 January, 2024	Time	11:30 AM

Attendees	*Name*	*Affiliation*	*Present/ Absent*
	Rahma Al Ghafailiya	Head of OWA Liwa	Present
	Fatima Al Saadi	Deputy Head of OWA Liwa	Present
	Fatima Al Owaini	Head of the Media Committee	Present
	Moza Mohammed Al Maamari	Head of the Religious Committee	Present
	Moza Al Briki	Member of OWA Liwa	Present
	Rayya Al Reisi	Member of OWA Liwa	Present
	Meera Salemin Salim	Member of OWA Liwa	Present
	Buthaina Al Roushdi	Member of OWA Liwa	Present
	Maryam Al Maqbali	Member of OWA Liwa	Present
	Moza Rashid Al Maamari	Member of OWA Liwa	Present
	Sara Al Kendi	Member of OWA Liwa	Present
	Sabha Al Maqbali	Member of OWA Liwa	Present
	Fatima Al Balushi	Member of OWA Liwa	Present
	Moza Al Raisi	Member of OWA Liwa	Present
	Dhahyuh Al Maamari	Member of OWA Liwa	Present
	Moza Al Azri	Health and Safety Engineer / TE	Present
	Dalal Darwish	Social Wire	Present
	Rayyan Al Balushi	5OES	Present

Recorded by	Dalal Darwish, Rayyan Al Balushi	Issue	Draft 1
Distribution	Client/Company: TotalEnergies, OQ, SIPC	Sheet 1 of 2	

Agenda Item/Discussion Points

Impact Distance from Marsa LNG Project

- Participants raised concerns about the impact distance from the MARSA LNG project to the closest surrounding village, questioning the noticeable emissions in their villages due to wind blow.

Participants acknowledged Harmul as the closest village in proximity to the Project, stating that it is 'merely a few footsteps away from the Sohar Industrial Port Area (SIPA)'.

Agenda Item/Discussion Points

Gas Pipe Leakage and Safety Measures

- The Project team addressed concerns about potential gas pipe leakage and the risk of explosions. They reassured attendees that the company adheres to rigorous standards and has comprehensive plans in place to ensure maximum safety within the Project facility.

Regular Maintenance in Project Site

- The Project team confirmed that there will be regular maintenance conducted in the Project site, ensuring the ongoing functionality and safety of the facilities.

Health and Safety of Project Workforce

- Participants inquired about the health and safety measures for the workforce operating in the Project. The Project team assured that the workforce would be safe and unaffected in terms of health. They would receive necessary medical treatment and be equipped with proper safety gear, including protective gloves.
- Participants emphasized the importance of prioritizing employment for job seekers from the wilaya of Liwa.

Health Concerns and Employment Prioritization

- Participants shared concerns regarding the increased incidence of health issues, such as cancer and miscarriages, which they believed to be associated with industrial operations in SIPA. Specific mention was made of Uqdat al-Mawani village, where complaints about a noticeable gas smell were raised.
- A detailed method for employment prioritization was proposed, suggesting that locals provide a comprehensive list of job seekers along with their qualifications. This information could then be considered by the operating company for suitable positions.
- Participants strongly advocated for employment opportunities from the wilaya, expressing their disapproval if the company chose to employ from outside the area.

Village Relocation and Public Site Visits

- Participants conveyed the sentiments of the people in Harmul village, expressing discontent with the close proximity of the Sohar Industrial Port Area (SIPA) and made suggestions to relocate Harmul village, as done with like Hallat Al Sheikh and Gadhafan.
- Participants proposed that the TotalEnergies, the operating company for the MARSA LNG Project, could allow the general public to visit the site during the construction phase. This visitation was seen as a means to provide transparency and assurance of the ongoing progress of the Project.

Support for Omani Women's Association (OWA)

- Participants sought support for the Omani Women's Association (OWA), specifically mentioning the provision of furniture as a form of support.
- In a recent incident, participants communicated their dissatisfaction regarding the absence of support from Oman LNG. While other OWAs received buses, the OWA of Liwa only received a rejection/apology letter, raising concerns about unequal support.

Minutes of Meeting

Project Title	MARSA LNG Bunkering Project	Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with Ghiras and Takaful Charity Teams	Location	Sohar
Date	Monday, 8 January, 2024	Time	13:00 PM

Attendees	*Name*	*Affiliation*	*Present/ Absent*
	Hilal Al Shizawi	CEO of the Takaful Foundation	Present
	Ahmed Al Maqbali	Member of the Takaful Team	Present
	Mohammed Al Jabri	Director of the Ghiras Charity Team	Present
	Ahmed Al Burmani	Member of the Ghiras Charity Team	Present
	Mahmoud Al Balushi	Member of the Ghiras Charity Team	Present
	Moza Al Azri	Health and Safety Engineer / TE	Present
	Bertrand Schwartz	Marsa LNG HSE Manager	Present
	Olivier Darneau	Social Performance Advisor/ TE	Present
	Dalal Darwish	Social Wire	Present
	Haitham Al Wahaibi	5OES	Present
	Rayyan Al Balushi	5OES	Present

Recorded by	Dalal Darwish, Haitham Al Wahaibi, Rayyan Al Balushi	Issue	Draft 1
Distribution	Client/Company: TotalEnergies, OQ, SIPC	Sheet 1 of 2	

Agenda Item/Discussion Points

Environmental Impact

- Participants expressed negative impacts from companies operating in the Sohar Industrial Port in the form of pollution. Mentioned that many affected villages have been relocated due to pollution.

Nature of MARSA LNG Project

- Question raised by charity team members: Will the MARSA LNG Project be a gas production plant or just an export or fueling facility?
- Answer provided by Project team: The liquification of natural gas will be carried out on the Project site, and the gas will be supplied to the site through the Natural Gas Transportation Network managed by OQGN.

Social Investment Initiatives

- Participants stated that social investment initiatives from Sohar port companies are often intangible compared to the companies' revenue. It was also emphasized that charity teams should be considered in the planning of social investment projects, as they are close to the community and aware of its needs.

Benefits to Charity Teams

- Participants confirmed that charity teams, Ghiras and Takaful, currently do not receive benefits given to the Wali and/or Governor.
- Participants highlighted that Ghiras and Takaful often collaborate on projects supporting local education, health, and general social services.

Impact of Waste on Surrounding Villages

- Participants mentioned that waste generated by companies in Sohar Port negatively impacts surrounding villages. They expressed concern about the visible increase in flare levels, suggesting that affected communities should receive compensation or effective initiatives.

Employment and Priority for Local Jobseekers

- The Project team clarified that the MARSA LNG Project will follow OQ guidelines for employment and comply with the local employment system.
- The recruitment plan for the Project aims to employ 120 people during the operational phase.
- Participants emphasized the importance of prioritizing jobseekers from the Project area, advocating for a workforce composition of 50% from the local community. This emphasis stems from the belief that the residents around the Project area are significantly impacted by the operations of companies in the Sohar Port.
- Participants warned that the lack of benefits and compensation may lead to increased grievances.
- Participants stressed the importance of transparent and inclusive recruitment processes, suggesting that local universities and institutions should play a role in providing suitable candidates.

TotalEnergies' Role in Recruitment

- A participant familiar with OQ's recruitment system stated that TotalEnergies should specify employing graduates and job seekers from the wilaya and local universities and institutions. Emphasized that the people of the wilaya should have a higher priority in employment.

Effectiveness of Benefits and Social Initiatives

- Participants suggested that benefits and social initiatives directed to local charity teams and sports clubs are more effective, powerful, and well-received by the local community. It was also mentioned that such initiatives improve a company's reputation among the local community and social media followers.

Feedback Form Process

- Participants commented on the online feedback form, stating it cannot be instantly filled online and suggested that the process should be simplified. They recommended making the form more user-friendly, possibly allowing for real-time online submissions, to encourage more responses from the local community.




Minutes of Meeting

Project Title	MARSA LNG Bunkering Project		Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with the Omani Women Association (OWA) in Sohar		Location	OWA of Sohar, Sohar
Date	Monday, 8 January, 2024		Time	18:30 PM
Attendees	*Name*	*Affiliation*	*Present/ Absent*	
	Fadhila Al Ruhailiya	Head of OWA Sohar	Present	
	Khadija Al Nofliya	Deputy Head of OWA Sohar	Present	
	Moza Al Azri	Health and Safety Engineer / TE	Present	
	Dalal Darwish	Social Wire	Present	
	Rayyan Al Balushi	5OES	Present	
Recorded by	Dalal Darwish, Rayyan Al Balushi		Issue	Draft 1
Distribution	Client/Company: TotalEnergies, OQ, SIPC		Sheet 1 of 2	

Agenda Item/Discussion Points

Stakeholder Engagement

- Participants raised a question about whether the operating company sought opinions from people living in the areas closest to the Project location.
- The Project team confirmed that 5OES had undertaken public engagements, conducting 35 meetings with various stakeholders and recording their comments and concerns.

Emissions and Environmental Impact

- Participants expressed concerns about gas emissions from Sohar Port, noting that while operating companies often claim minor impacts, local communities reported adverse effects on plants and trees.
- Issues highlighted included a noticeable decrease in plant and tree health, attributed to residues left by gas emissions/pollution.
- Residents from Majis village reported the presence of a white powdery residue affecting their belongings and their eyes, indicating a potential connection to operating companies. A participant proposed either relocating Majis village or offering financial compensation.

Health Impacts and Compensation

- Participants believed that Projects in Sohar Port adversely impacted the health of locals, particularly the elderly. Seeking compensation, they emphasized the need for support with medical treatment or financial compensation.

Employment Practices

- Concerns were raised about the employment/recruiting system, with participants contending that it did not benefit the local communities of Wilayat Liwa and Sohar. They advocated for prioritizing the local community in employment processes, starting with suitable candidates locally and only employing from outside if required skills were not found within.

Distribution of Social Responsibility

- Participants emphasized that social responsibility and benefits from the MARSA LNG Project be preferably directly distributed to smaller groups like Omani Women's Associations and charity groups, bypassing Walis or Governor Offices as the OWA has not received benefits when funding is directed to the Wali or Governor offices.

Agenda Item/Discussion Points

- OWA approached companies seeking support but faced rejection. Timing challenges were acknowledged, with companies suggesting that the request should have been made earlier in the year or at the beginning of the next year.

Community Expectations and Limited Support

- Participants expressed discontent and unfulfilled expectations from companies operating in the area.
- The need for valuable social investment initiatives and services for the local community was emphasized, as small compensations or donations were deemed insufficient and intangible.
- Youth-led cleanup campaigns received no support from big companies in Sohar Port, highlighting limited social support.

Stakeholder Communication and Engagement

- Participants stressed the importance of continuous communication and engagement with stakeholders throughout all phases of the MARSA LNG Project.

Future Stakeholder Engagements

- Participants suggested that Omani Women's Association arrange meetings at schools within affected areas for better community representation. This approach, including inviting members of the parents' council/association, and teachers, was proposed to be more effective than handing over surveys and feedback forms. The participants believed that this approach would ensure better and more representative feedback, offering the team their coordination support to arrange such meetings.

مشروع مرسى لتزويد السفن بالغاز الطبيعي المسال
عرض المشروع وتقييم الأثر البيئي والاجتماعي(ESIA)
التاريخ : يناير 2024
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Minutes of Meeting

Project Title	MARSA LNG Bunkering Project	Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with the Fishermen	Location	Sohar
Date	Monday, 8 January, 2024	Time	20:30 PM

Attendees

Name	*Affiliation*	*Present/ Absent*
Saeed Mohammed Khamees	Local Fisherman	Present
Jasim Al Saadi	Local Fisherman	Present
Abdullah Jasim Al Balushi	Member f Sunan Al Bahr Committee in Sohar	Present
Abdulrahman Al Maamari	Local Fisherman	Present
Adel Khasif Al Maamari	-	Present
Moza Al Azri	Health and Safety Engineer / TE	Present
Bertrand Schwartz	Marsa LNG HSE Manager	Present
Olivier Darneau	Social Performance Advisor/ TE	Present
Dalal Darwish	Social Wire	Present
Haitham Al Wahaibi	5OES	Present
Rayyan Al Balushi	5OES	Present

Recorded by	Dalal Darwish, Haitham Al Wahaibi, Rayyan Al Balushi	Issue	Draft 1
Distribution	Client/Company: TotalEnergies, OQ, SIPC	Sheet 1 of 2	

Agenda Item/Discussion Points

Impact of Industrial Operations on Fishing Activity

- Participants confirmed the adverse effects of industrial operations in the Sohar Port Area on fishing activity, particularly in Harmul, located approximately 200 meters from the port.
- Concerns were raised about possible gas leakage and potential impacts on fishermen and their catch.
- Participants reported direct impacts, particularly noting the appearance of a white powdery residue on cars in nearby communities and a persistent bad smell/odour.

Unfulfilled Expectations, Engagement Fatigue, and Past Impact of Operations

- Comments from participants conveyed a sense of unfulfilled expectations and engagement fatigue.
- Grievances were expressed regarding the direct impacts of previous companies' operations, including issues such as noise from jetty hammering, cracks in houses, and building damage.

Utilization of Seawater and Flare Usage

- Participants raised concerns about the use of seawater for Project operations.
- The Project team clarified that seawater would not be used, and an air-cooling system would be employed.
- Inquiries about flare usage were addressed, with the Project team assuring that flares would only be used in emergency situations.

Employment and Partnership with Local Contractors

- Participants emphasized the need for prioritizing local employment and advocated for partnerships and contracts with local contractors and SMEs.
- Participants suggested exploring the transfer of temporarily employed candidates to stable positions at the Project headquarters upon completion.

Impacts on Fishing Activity and Community Solutions

- Participants highlighted that an increase in the presence of rocks in the water surrounding the Port area are causing damages to their boats, which they perceive to be due to ongoing Port industrial activities and operations. Participants also claimed that this is linked to an increase in mosquito activity and population in the area. Participants stressed the importance of companies identifying and addressing these impacts before commencing operations.
- An example was given about negative impacts, stating that due to dredging activities, fishermen had to relocate where they park their boats, far from their houses, leading to incidents of stolen boat engines. Despite communicating these incidents to the Wali, the fishermen received no response.

Continuous Engagement of the Fishermen Community

- Participants emphasized the essential role of fishermen within the community.
- Participants emphasized the need for regular and continuous engagement with the fishermen community throughout all phases of the MARSA LNG Project.

Issues Faced by Fishermen Community and Request for Support

- Participants requested general employment support, proposing the provision of jobs like drivers or security guards during the early stages of the Project.
- Participants suggested providing a list of jobseekers without academic qualifications for temporary employment, with the option for evaluation and potential long-term positions.
- An open day for employment opportunities was proposed.
- Participants emphasized the challenges faced by fishermen when applying for loans due to the absence of salary statements.
- They expressed a preference for direct access to services without involving intermediary parties.
- Cited Oman LNG's direct initiatives, such as financial support for electricity and plantation, as positive examples.
- Participants suggested providing support to fishermen by supplying them with boats and GPS devices.

Minutes of Meeting

Project Title	MARSA LNG Bunkering Project	Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with the Wali of Liwa's Office	Location	Wali of Liwa's Office, Liwa
Date	Tuesday, 9 January, 2024	Time	08:30 AM

Attendees

Name	*Affiliation*	*Present/ Absent*
Hilal Sultan Hamad Al Kalbani	Wali of Liwa	Present
Ahmed Saeed Abdullah Al Sharqi	Shura Council Member in Liwa	Present
Saif Khaled Saif Al Risi	Shura Council Member in Liwa	Present
Khalfan Salem Ali Al Maamari	Sheikh of Harmoul Village	Present
Ahmed Khalfan Ahmed Al Ghafili	Representative of Liwa Village	Present
Adel Mohammed Ahmed Al Balushi	Member of the Municipal Council in Liwa	Present
Ali Rashid Mohammed Al Maamari	Representative of the Sheikh of Al Ghazeel Village	Present
Khalfan Suleiman Msabah Al Kindi	Member of the Municipal Council in Liwa	Present
Salman Saeed Khalfan Almuhari	Representative of the Sheikh of Ghdafan Village	Present
Saeed Al Balushi	Administration and Government Relations Manager / SIPC	Present
Mohamed Ambusaidi	Environmental Affairs Manager / SIPC	Present
Jameel Al Hajri	Project Development Manager / OQ	Present
Mohammed Al Saifi	Manager Security at OQ EP	Present
Mahmoud Al Badi	Social Investment/OQ	Present
Moza Al Azri	Health and Safety Engineer / TE	Present
Bertrand Schwartz	Marsa LNG HSE Manager	Present
Olivier Darneau	Social Performance Advisor/ TE	Present
Dalal Darwish	Social Wire	Present
Haitham Al Wahaibi	5OES	Present
Rayyan Al Balushi	5OES	Present

Recorded by	Dalal Darwish, Haitham Al Wahaibi, Rayyan Al Balushi	Issue	Draft 2
Distribution	Client/Company: TotalEnergies, OQ, SIPC	Sheet 2 of 3	

Agenda Item/Discussion Points

Project Cost

- The Liwa Wali's Office requested details on the Project's cost, with the Project team confirming it to be a substantial budget of around 1.700 billion USD.

Chronic Emission Monitoring and Impact on Communities

- The Wali's Office expressed concern regarding potential harmful gas emissions, whether visible or invisible, that may cause direct harm to communities near the project.
- The Marsa LNG Project team assured proactive measures and no routine flaring, stating that emissions would be minimized and flaring would only occur in the case of emergency, commissioning, and shutdown. A management plan aligned with the Environment Authority, Omani regulations, international conventions, and best practices and procedures is in place.
- Emphasis was placed on joint monitoring efforts by TotalEnergies and the Environment Authority, regarding the implementation of requirements to reduce environmental emissions.

Shutdown and Accidental Gas Leaks

- The Wali's Office raised concerns about increased emissions during shutdowns and other maintenance purposes, particularly due to the nature of the gas product.
- The Marsa LNG Project team highlighted community engagement strategies to address environmental concerns and received grievances, acknowledging potential risks associated with gas leaks, in addition to necessary emergency plans to be implemented.

Raw Material Source

- Questions were raised about the source of natural gas for the Project.
- The Project team clarified that the gas will be supplied through the Natural Gas Transportation Network (managed by OQGN).

Area of Influence and Health & Safety Impacts

- Queries were made regarding the safe legal distance for residential areas in proximity to the Project, specifically when considering accidental gas emissions.
- The Project team explained that the impact assessment of the facility integrates among other things, wind directions. The study covered the Sohar port and a 2 km radius around Sohar Port, including the 12 closest villages directly affected by the Project. Emergency analysis focused on a maximum distance of approximately 500m for such facilities according to TotalEnergies' standards, with calculations tailored for each village, factoring in variables such as wind direction.
- Meeting participants specifically mentioned the closest village, Harmul, as it has not been relocated yet, raising additional community considerations due to its proximity to the Project.
- In response to concerns, the Project team provided insights into potential health impacts, clarifying that health issues would only arise in case of direct contact with specific gases. Accidents and direct contact could lead to anoxia/ poisoning, but the impact is limited within the close vicinity of facilities/equipment and anyway within the port area.

Employment Opportunities and Local Impact

- Meeting participants emphasized local employment, requesting 80% of the Project employees to be from the Wilayah of Liwa.
- Concerns were voiced about perceived unfair employment practices, including a historical trend of hiring from outside the wilayah.
- The Marsa LNG Project team responded that adopting a specific employment rate of 80% is challenging, given that technical and leadership specializations depend on qualifications and experience. However, they assured that applicants from the wilayats of Liwa and Sohar will be given priority consideration for the available job opportunities.
- Social and economic impacts on Liwa were discussed, with a requested emphasis on supporting local SMEs and prioritizing benefits for impacted villages.
- Members from the Wali's office meeting highlighted that more than 3000 individuals, including skilled and qualified job seekers, are currently unemployed in the wilayah.

Agenda Item/Discussion Points
• An observation was made about high-grade positioned employees historically employing their relatives from outside the wilayah, sparking concerns about fairness in the employment process. • A member stressed, "Don't give our net to those outside the region," indicating a strong desire for local employment where he advised that, Marsa LNG management should initiate its support opportunities for SMEs in the wilayah. Marsa LNG responded that by default, the percentage of employment opportunities is also expected to increase through such contracted SMEs to the Project. • The negative impacts on Liwa, particularly on farms and houses, were pointed out. • The Sheikh of Gadhafan emphasized the need for prioritized employment, given the proximity of their community to the Sohar port boundary. • It was suggested that local SMEs should be supported with necessary equipment, and benefits should prioritize impacted villages, fishermen, and animals (domestic livestock). • Members agreed that if the required skills, qualifications, and experience are unavailable within the wilayah, employing from outside is acceptable, provided it is justified and transparent.
Social Investment and Project Start Date • The Project team stated the expected start date as the third quarter of 2024 (summer).
General • General sentiment about the perception of benefits such as social investments, subcontracts and employment opportunities for Liwa have been insufficient in comparison to the profits of all the entities in Sohar Industrial Port Area (SIPA). • General inquiries were made regarding the percentage of benefits allocated for social investment.
Action Points • 5OES to share a detailed meeting minutes and Project disclosure slides with the Wali of Liwa's office.




Minutes of Meeting

Project Title	MARSA LNG Bunkering Project	Project/File No.	M14035
Subject	MARSA LNG ESIA Public Disclosure Meeting with the Wali of Sohar's Office	Location	Majan Hall, Sohar
Date	Tuesday, 9 January, 2024	Time	11:30 AM

Attendees	*Name*	*Affiliation*	*Present/ Absent*
	Ahmed Mohammed Shahab Al Balushi	Deputy Wali of Sohar	Present
	Ahmed Salem Al Hujari	Head of Labor Affairs in North Al Batinah Governorate	Present
	Khaled Saeed Al Saadi	Head General of Health Services in North Al Batinah Governorate	Present
	Abdullah Ali Suleiman Al Balushi	Member of the Shura Council in Sohar	Present
	Khaled Hamad Obaid Al Rubkhi	Son of the Sheikh of Majees Village	Present
	Yahya Mohammed Khadim Al Jabri	Representative of Al Khawairiya Village	Present
	Naji Hamoud Saeed Al Rubei	Representative of Falaj Al Qabail Village	Present
	Abdul Rahman Hamdan Bakhit Al Ansari	Representative of Majees Village	Present
	Ahmed Ali Salem Al Jabri	Representative of Falaj Al Qabail Village	Present
	Sulaiman Fadl Ali Al Jabri	Representative of Falaj Al Qabail Village	Present
	Saeed Muftah Saeed Al Fazari	Representative of the Environmental Department in North Al Batinah Governorate	Present
	Saeed Al Balushi	Administration and Government Relations Manager / SIPC	Present
	Mohamed Ambusaidi	Environmental Affairs Manager / SIPC	Present
	Khalifa Al Muqbali	Government Affairs Officer/ SIPC	Present

	Jameel Al Hajri	Project Development Manager / OQ	Present	
	Mohammed Al Saifi	Manager Security at OQ EP	Present	
	Mahmoud Al Badi	Social Investment/OQ	Present	
	Moza Al Azri	Health and Safety Engineer / TE	Present	
	Bertrand Schwartz	Marsa LNG HSE Manager	Present	
	Olivier Darneau	Social Performance Advisor/ TE	Present	
	Dalal Darwish	Social Wire	Present	
	Haitham Al Wahaibi	5OES	Present	
	Rayyan Al Balushi	5OES	Present	
Recorded by	Dalal Darwish, Haitham Al Wahaibi, Rayyan Al Balushi		Issue	Draft 2
Distribution	Client/Company: TotalEnergies, OQ, SIPC		Sheet 2 of 3	

Agenda Item/Discussion Points

General Environmental and Health Concerns

- The Wali's Office of Sohar raised concerns regarding the Project's overall environmental and health impact and were keen to understand what measures and procedures were in place to address these concerns.
- A suggestion was made for the Project team to produce a detailed booklet summarizing the Project's health and environmental outcomes, including instructions on how to address potential impacts.

Flare and Safety Measures

- The participants inquired about the presence of a flare in the Project and its expected impact on villages near the station, as well as the procedures followed.
- The Marsa LNG Project team confirmed the absence of a visible continuous flare. It will only operate during emergencies, shutdown and other maintenance purposes and will not cause any accidents and will have limited and temporary environmental impact.
- The Project team offered further clarification by emphasizing that the likelihood of gas leakages is minimal, with potential occurrences primarily associated with specific incidents such as flange leak, pipe rupture, or in the worst-case accidents at sea.

Detectors and Social Responsibility

- The Wali Sohar office participants raised questions about potential negative impacts from the LNG Project.
- The Project team assured the installation of fire and gas detectors for timely accident detection, contributing to a safe environment and reinforcing emergency response procedures.
- Collaboration efforts with the Environment Authority were emphasized to ensure proactive management of potential risks.
- Attendees stressed the importance for companies to consider the social status of the community and actively support local initiatives, including fishermen, sports and charity clubs.

Employment Strategies

- Participants inquired about the percentage of employment that would be sought from the Wilayah of Sohar.
- The Marsa LNG Project team responded that adopting a specific percentage for the employment rate is challenging, as technical and leadership specializations depend on qualifications and experience. However, applicants from the wilayats of Liwa and Sohar will be given priority consideration to compete for the jobs offered. Additionally, the Project team mentioned that, by default, the percentage of employment opportunities is expected to increase through contracted SMEs for the Project.
- A concern was expressed by a member from the Ministry of Labour of North Batinah regarding the provision of temporary/contract jobs, emphasizing the importance of stable employment opportunities. This member highlighted that North Batinah governorate has 840 engineering graduates (both male and female) who have completed their courses abroad and are currently unemployed.

Agenda Item/Discussion Points
• The Marsa LNG Project team clarified, in accordance with labor law, that a company cannot be granted a work permit/license if it hires subcontractors without electronic registration through the Ministry of Labour portal. • Another concern was raised by a participant, pointing out the presence of 44 plants in the area. This participant emphasized that these companies should contribute to the community by providing services in various capacities.
International Social Investment Models • A suggestion was made to explore international examples of social investment Projects and initiatives. • A specific example was mentioned from the UK, wherein 88 neighboring households received tangible benefits, including upgraded infrastructure and support with sewage systems.
Emergency Coordination and Leakage Management • The Project team affirmed their ongoing coordination with SIPC throughout all stages of the Project, ensuring seamless collaboration in the development and implementation of emergency and leakage management plans.
Concerns about Employee Numbers • A member from the Shura Council expressed concern about the perceived low number of employees (~120) compared to the Project's high cost of capital expenditure. • The Marsa LNG Project team clarified that the mentioned figure pertained to the number of employees working as operators during the operation at the Project site and furthermore the percentage of employment opportunities is also expected to increase through such contracted SMEs to the Project.
Action Points • 5OES to share a detailed meeting minutes and Project disclosure slides with the Wali of Sohar's office.


شكرا

ANNEX C STAKEHOLDER ENGAGEMENT LOG

Management Plan	Description of Commitment	Section (Reference)	Engagement Action	Specific engagement activities	Engagement Type (*Meeting, workshop, Key informant interview, focus*	Engagement Objective (*information disclosure, consultation,*	Stakeholder (*county government, local leadership, local communities,*	Implementation Schedule and Milestones (First 6 months)																								Monitoring			
								February				March				April				May				June				July				Post 6 months	Status	Synergies with other plans	Deliverables	Monitoring KPI
								W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4					

ANNEX D SAMPLE OF GRIEVANCE COMMUNICATION FORM

<table>
<tr><th colspan="2">Stakeholder Grievance Mechanism</th></tr>
<tr><th colspan="2">Grievance Registration Form</th></tr>
<tr><td>Grievance Reference From:</td><td>Grievance Reception Date (dd/mm/year):</td></tr>
<tr><td colspan="2">Full Name of person registering the grievance:</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Full Name of Complainant:</td></tr>
<tr><td>Contact Information

Please mark how you wish to be contacted (telephone, mail, e-mail).</td><td>By Telephone: ____

By Post: Please provide mailing address:
____
____
____

By E-mail:
____</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Description of Grievance:</td><td>When did it happen (date and time)? What happened? Where did it happen? Who did it happen to? What is the result of the problem? Were there any witnesses? (Continue on additional pages as required)</td></tr>
<tr><td>Date of Grievance

------</td><td>One time grievance (date _______________)
Happened more than once (how many times? _____)
On-going (currently experiencing problem)</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">What would you like to see happen to resolve the problem?</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Signature: _______________________________ Date:
____
Please return this form to:</td></tr>
</table>

ANNEX E GRIEVANCE LOG TEMPLATE

No.	Grievance #	Date Received	Acces Point	Received by	Name of Complainant	Community of origin	Brief Complaint/Grievance Descripton	Category

Acknowlogement date	Response by	Associated Department	Complaing owner	Proposed Resolution / feedback	Preliminary Resolution Date	Satisfied with Process (yes/no?)	If not, why not?	Conclusive resolution date	Satisfied with Process (yes/no?)	If not, why not?	Closure Date

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APPENDIX C AIR QUALITY MODELLING

Reference:	SIPC/Sustain.Dep/2023/057
Date:	July 2023 - Version 005
Title :	Comprehensive Air Dispersion modeling for TOTAL LNG Plant emission (CO, NOx, PM and SO_2) to ambient air
Prepared by:	SOHAR as requested by TOTAL

1 Background

Total Exploration & Production Oman Development (BV Branch) is proposing to develop a regional hub for Liquefied Natural Gas (LNG) bunkering in the Sultanate of Oman, to supply LNG as a fuel to marine vessels. This is planned to be achieved through the downstream development of a new 1 Million Ton Per Annum (MTPA). The LNG plant will be built on the reclaimed land in the Sohar Port Industrial Area (SIPA). Gas from the local Oman pipeline grid will be treated, liquefied, and stored onshore to provide an LNG fueling (i.e. bunkering) service to marine vessels via a dedicated LNG marine terminal in SOHAR Port.

TOTAL approached SIPC to support them to complete air impact from the plant using the air dispersion modeling software and prepare a comprehensive air dispersion modeling for plant stack in order to evaluate the additional impact from the new plant to the existing port operations. TOTAL LNG plant shall have two operating scenarios (normal operation and start-up) from the plant. The emission sources for the plant are:

1. Normal operation scenarios:
    a. Thermal Oxidator NRU
    b. Thermal Oxidator AGRU
2. Start-up (6 times per year)
    a. Flare Warm
    b. Flare Cold

SOHAR team run the model as per the current operation and another run with additional emission from the new proposed plant. SOHAR operates lakes environmental AERMOD and have the required data/tools to conduct study of the impact of such changes/additional in emission concentrations.

2 Objective

This study will focus on the additional impact shall the plant add to CO, NOx, SO2 and PM concentrations in the surrounding environment of SOHAR Port and Freezone.

3 Model software and setup

SOHAR has an air dispersion model tools using AERMOD that have all the stacks sources from the Port and Freezone. The AERMOD modeling system is a comprehensive modeling tool that includes meteorological data (surface, upper air, precipitation, and wind rose) processors, geophysical data processors, a diagnostic meteorological model, dispersion model, and post-processing modules. The modeling system is a multilayer, multi species non-steady-state for the plumes from the sources to the air and the settling velocity for each concentration based on the meteorological data in the same time. It is capable of modeling instant or continuous releases over distances starting from tens of meters to many kilometers.

Background concentrations of the area was measured using SOHAR's AQMN data as the following:

Table 1: Baseline of Air Quality in SOHAR Port and Freezone

Parameter	Averaging period of measurements	Cons (2019)	Cons (2020)	Cons (2021)	Unit
CO	Annual	0.29	0.296	0.292	mg/m3
Ozone	Annual	61.76	69.91	47.97	mg/m3
NO2	Annual	24.85	18.44	20.62	µg/m3
PM10	Annual	134.30	193.32	134.30	µg/m3
NMHC	Annual	169.54	164.25	151.47	µg/m3
SO2	Annual	12.86	17.52	13.80	µg/m3

Averaging period of measurements in the above table were calculated based on validated short-term data of 1 hour for each of the above-mentioned parameters to calculate the annual average for each year for all air quality stations.

The coordinates for the AQMN stations and other main receptors in the area were defined in the software as sensitive receptors as shown in Table 2.

Table 2: sensitive receptors locations coordinate

No	Location Name	Coordinates	
		Easting	Northing
1	Zafran Station*	469600	2700243
2	Ghadfan South Station*	458963	2707208
3	Ghadfan North Station*	460375	2705608
4	Aqdat Al Mawani'a Station*	457129	2709747
5	AL Hadd	457719	2708621
6	Harmoul	459061	2712733
7	Liwa RA	455538	2711688
8	New Liwa	451583	2716009
9	FAQ RA	460567	2701221
10	Majees	465207	2704516
11	Al Ghushbh	466672	2698516
12	Majan	456948	2698841

*stations is referred to AQMN stations

Meteorology data is a key input data that is required for running modeling system. The AERMET data, which is hourly data from 2012 to 2019, a diagnostic model, requires gridded meteorological data as input to the model. Those data purchased from the AERMOD developer based on the location order, which was Sohar Port and Freezone Area. The data was then processed in AERMET as MM5 as per the location coordinates provided by the user which are (460121 m E, 2708265 m N). After finalizing the met data, the AERMOD study area were defined as the following (451000 m E, 2695000 m N) then 25 km to the east and north and complete the square of 25 km x 25 km that cover the Port and the Freezone influence area. The terrain elevation and land use data for the modeling domain was obtained from AERMOD as elevated/ flat. The plant's plot elevation is estimated to be 4 m above the main sea level. NO_2 model completed estimated the worst case of full conversion of NOx to NO_2. The short term modeling results for SO_2 and NO_2 , NAAQS was considered for multi-years avenger of ranked maximum values. The emission concentrations were estimated and provided by TOTAL as per Table 3.

Table 3: Modeling Inputs

<table>
<tr><th colspan="2">Sources ID</th><th rowspan="2">Unit</th><th colspan="2">Thermal Oxidator - AGRU</th><th colspan="2">Thermal Oxidator - NRU[1]</th><th>Flare 2 Warm</th><th>Flare 3 Cold</th></tr>
<tr><th colspan="2">Operating Mode</th><th colspan="2">Normal only</th><th colspan="2">Normal only</th><th>Start up only</th><th>Start up only</th></tr>
<tr><td colspan="2">Latitude</td><td>m</td><td colspan="2">462373</td><td colspan="2">462373</td><td>462505</td><td>462505</td></tr>
<tr><td colspan="2">Longitude</td><td>m</td><td colspan="2">2708189</td><td colspan="2">2708189</td><td>2708557</td><td>2708557</td></tr>
<tr><td colspan="2">Based elevation</td><td>m</td><td colspan="2">4</td><td colspan="2">4</td><td>4</td><td>4</td></tr>
<tr><td colspan="2">Stack Height</td><td>m</td><td colspan="2">24</td><td colspan="2">24</td><td>178 [2]</td><td>178 [1]</td></tr>
<tr><td colspan="2">Gas exit temp</td><td>°C</td><td colspan="2">250</td><td colspan="2">250</td><td>1000</td><td>1000</td></tr>
<tr><td colspan="2">Gas exit Velocity</td><td>m/s</td><td colspan="2">20.7</td><td colspan="2">20</td><td>20</td><td>20</td></tr>
<tr><td colspan="2">Flow rate</td><td>m^3/s</td><td colspan="2">3.769</td><td colspan="2">3.617</td><td>19.91</td><td>19.8</td></tr>
<tr><td colspan="2">Stack diameter</td><td>m</td><td colspan="2">0.48</td><td colspan="2">0.48</td><td>9 [3]</td><td>8.8 [2]</td></tr>
<tr><td rowspan="5">Emission rate</td><td>NOx</td><td>g/s (mg/m^3)</td><td colspan="2">0.1888(51)</td><td colspan="2">NA</td><td>22.6581</td><td>21.758</td></tr>
<tr><td>SO_2</td><td>g/s (mg/m3)</td><td colspan="2">0.8005(212)</td><td colspan="2">NA</td><td>NA</td><td>NA</td></tr>
<tr><td>CO</td><td>g/s (mg/m3)</td><td colspan="2">NA</td><td colspan="2">NA</td><td>123.2868</td><td>118.3988</td></tr>
<tr><td>PM</td><td>g/s (mg/m3)</td><td colspan="2">0.0376 (10)</td><td colspan="2">NA</td><td>NA</td><td>NA</td></tr>
<tr><td>Others</td><td>g/s (mg/m3)</td><td>C6H6</td><td>0.0019 (0.5)</td><td>CH4</td><td>0.00701[4]</td><td>NA</td><td>NA</td></tr>
</table>

Difference scenarios developed as per the discussion between SOHAR and TOTAL teams to give best picture of the impact of different scenarios of operation to the ambient air sounding the environmental. It was agreed to use the following scenarios:

1. Currant operational (SPF)
2. Currant operational (SPF) + TOTAL LNG normal operation
3. Currant operational (SPF) + TOTAL LNG startup operation

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1 Data based on best engineering estimations.

2 Effective Release Height calculated according to the *EPA-454/R-92-024 Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised)*. Flare real height 138 meter

3 Diameter calculated according to the *EPA-454/R-92-024 Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised)*

4 Based on 99.5% efficiency destruction in NRU RTO resulting in 0.21t/year of vented CH4

4 Results

Based on the above input the model run, the below are model outputs as the following:

Table 4: Modeling Result for PM

No	Location Name	Currant operational (SPF) µg/m³		Currant operational (SPF) + TOTAL LNG normal operation µg/m³		Currant operational (SPF) + TOTAL LNG startup operation µg/m³	
		24hr	Annual	24hr	Annual	24hr	Annual
1	Zafran Station	139.55	135.1393	139.56	135.14	139.55	135.1393
2	Ghadfan South Station	142.18	135.8493	142.19	135.85	142.18	135.8493
3	Ghadfan North Station	145.01	138.1093	145.03	138.11	145.01	138.1093
4	Aqdat Al Mawani'a Station	140.59	136.0795	140.6	136.08	140.59	136.0795
5	AL Hadd	140.3	136.1795	140.31	136.18	140.3	136.1795
6	Harmoul	140.11	135.2194	140.12	135.22	140.11	135.2194
7	Liwa RA	140.72	134.8596	140.73	134.86	140.72	134.8596
8	New Liwa	137.07	134.5697	137.08	134.57	137.07	134.5697
9	FAQ RA	137.64	134.5698	137.65	134.57	137.64	134.5698
10	Majees	145.09	134.7686	145.11	134.77	145.09	134.7686
11	Al Ghushbh	138.33	136.8597	138.34	136.86	138.33	136.8597
12	Majan	136.93	134.7097	136.94	134.71	136.93	134.7097
MD 41/2017		150	-	150	-	150	-

Table 5: Modeling Result for CO

No	Location Name	Currant operational (SPF) µg/m³			Currant operational (SPF) + TOTAL LNG normal operation µg/m³			Currant operational (SPF) + TOTAL LNG startup operation µg/m³		
		1hr	8hr	1 yr	1hr	8hr	1 yr	1hr	8hr	1 yr
1	Zafran Station	633.35	386.99	294.09	633.35	386.99	294.09	648.26	390.24	294.29
2	Ghadfan South Station	644.71	368.24	294.99	644.71	368.24	294.99	669.62	377.83	296.17
3	Ghadfan North Station	599.15	341.10	296.57	599.15	341.10	296.57	624.33	349.61	297.60
4	Aqdat Al Mawani'a Station	613.74	393.01	297.66	613.74	393.01	297.66	634.93	399.43	298.08
5	AL Hadd	603.85	353.99	296.53	603.85	353.99	296.53	623.57	362.98	297.17
6	Harmoul	775.86	420.31	294.95	775.86	420.31	294.95	797.24	424.39	295.17
7	Liwa RA	577.20	372.14	293.05	577.20	372.14	293.05	594.59	376.90	293.29

No	Location Name	Currant operational (SPF) µg/m³			Currant operational (SPF) + TOTAL LNG normal operation µg/m³			Currant operational (SPF) + TOTAL LNG startup operation µg/m³		
		1hr	8hr	1 yr	1hr	8hr	1 yr	1hr	8hr	1 yr
8	New Liwa	530.06	363.48	291.88	530.06	363.48	291.88	543.26	366.66	292.00
9	FAQ RA	609.78	354.68	292.40	609.78	354.68	292.40	626.70	359.88	292.80
10	Majees	793.26	430.73	298.25	793.26	430.73	298.25	816.05	435.89	298.57
11	Al Ghushbh	727.14	380.73	292.24	727.14	380.73	292.24	741.54	385.68	292.47
12	Majan	1088.40	524.71	292.61	1088.40	524.71	292.61	1102.48	529.31	292.99
MD 41/2017		30,000	10,000	-	30,000	10,000	-	30,000	10,000	-

Table 6: Modeling Result for NO_2

No	Location Name	Currant operational (SPF) µg/m³			Currant operational (SPF) + TOTAL LNG normal operation µg/m³			Currant operational (SPF) + TOTAL LNG startup operation µg/m³		
		1hr	24hr	1 yr	1hr	24hr	1 yr	1hr	24hr	1 yr
1	Zafran Station	122.38	45.02	27.37	122.9	45.08	27.373	124.66	45.24	27.4
2	Ghadfan South Station	116.42	37.32	29.33	117.06	37.36	29.333	120.07	37.97	29.54
3	Ghadfan North Station	118.79	41.94	33.39	119.35	42.03	33.393	122.49	42.5	33.58
4	Aqdat Al Mawani'a Station	121.05	44.51	31.74	121.62	44.58	31.742	124.07	45.03	31.81
5	AL Hadd	113.43	38.21	31.32	114.09	38.28	31.322	116.68	38.8	31.43
6	Harmoul	135.88	36.48	26.56	136.46	36.54	26.562	138.76	36.77	26.6
7	Liwa RA	136.44	38.71	26.54	136.96	38.75	26.543	138.98	39.03	26.58
8	New Liwa	103.75	35.02	25.62	104.18	35.05	25.621	105.42	35.19	25.64
9	FAQ RA	102.18	35.03	26.59	102.62	35.06	26.591	104.89	35.38	26.66
10	Majees	159.63	57.06	28.91	160.26	57.17	28.911	163.37	57.4	28.96
11	Al Ghushbh	118.49	37.61	26.32	118.93	37.64	26.327	120.81	37.91	26.36
12	Majan	88.8	31.67	26.15	89.38	31.72	26.151	90.76	31.97	26.22
MD 41/2017		250	130	-	250	130	-	250	130	-

Table 7: Modeling Result for SO_2

No	Location Name	Currant operational (SPF) μg/m^3			Currant operational (SPF) + TOTAL LNG normal operation μg/m^3			Currant operational (SPF) + TOTAL LNG startup operation μg/m^3		
		1hr	24hr	1 yr	1hr	24hr	1 yr	1hr	24hr	1 yr
1	Zafran Station	63.34	18.45	9.64	65.57	18.7	9.65	63.34	18.45	9.64
2	Ghadfan South Station	83.13	20.58	12.3	86.24	20.75	12.31	83.13	20.58	12.3
3	Ghadfan North Station	81.38	21.35	12.59	84.45	21.75	12.6	81.38	21.35	12.59
4	Aqdat Al Mawani'a Station	65.79	16.36	10.61	68.65	16.66	10.62	65.79	16.36	10.61
5	AL Hadd	69.35	17.77	10.86	72.33	18.08	10.87	69.35	17.77	10.86
6	Harmoul	74.86	15.89	9.24	77.42	16.14	9.25	74.86	15.89	9.24
7	Liwa RA	71.83	15.54	9.162	74.12	15.72	9.17	71.83	15.54	9.162
8	New Liwa	55.49	13.53	8.794	57.4	13.68	8.8	55.49	13.53	8.794
9	FAQ RA	63.03	15.32	9.215	65.17	15.44	9.22	63.03	15.32	9.215
10	Majees	92.16	29.2	10.63	94.86	29.68	10.66	92.16	29.2	10.63
11	Al Ghushbh	71.56	14.75	9.124	73.46	14.89	9.13	71.56	14.75	9.124
12	Majan	58.17	12.47	9.074	60.84	12.69	9.08	58.17	12.47	9.074
MD 41/2017		350	150	-	350	150	-	350	150	-

Table 8: Modeling Result for Benzene

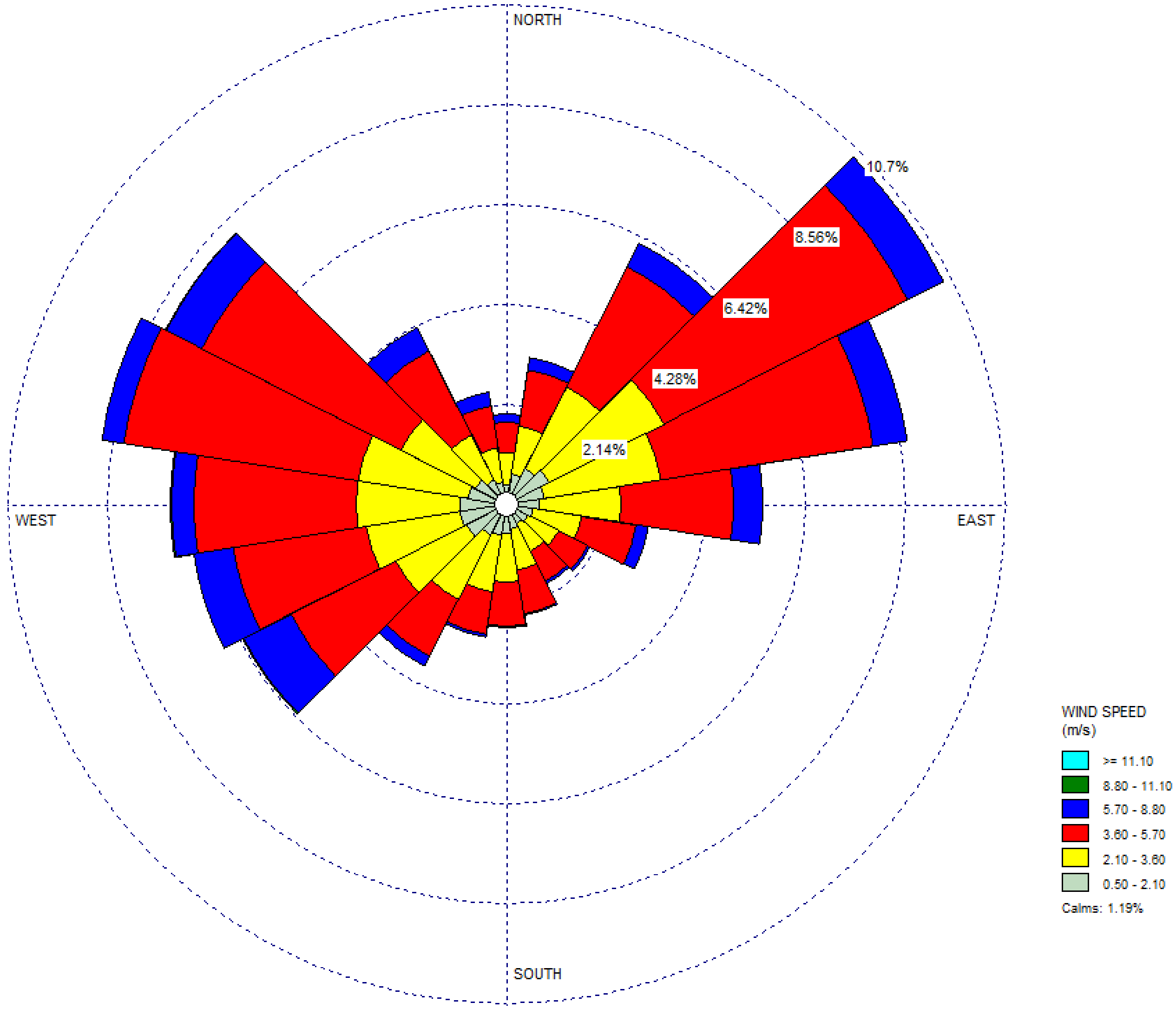
No	Location Name	TOTAL LNG normal operation μg/m^3		
		1hr	24hr	1 year
1	Zafran Station	0.00533	0.00061	0.00003
2	Ghadfan South Station	0.00837	0.00043	0.00004
3	Ghadfan North Station	0.00868	0.00097	0.0004
4	Aqdat Al Mawani'a Station	0.00748	0.00072	0.00002
5	AL Hadd	0.00780	0.00075	0.00003
6	Harmoul	0.00657	0.00061	0.00003
7	Liwa RA	0.00557	0.00043	0.00002
8	New Liwa	0.00476	0.00038	0.00001
9	FAQ RA	0.00553	0.00030	0.00001
10	Majees	0.00797	0.00114	0.00007
11	Al Ghushbh	0.00504	0.00035	0.00001
12	Majan	0.00717	0.00053	0.00001

5 Result Discussion

The above results shows that the additional impact from TOTAL LNG plant's sources has very acceptable contribution in air quality impact. It shows also the effect of emission changes during startup and normal operations of the plant and its effect to the main receptors. However, all the above results are within the MD 41/2017 limits for PM, CO, SO_2, and NO_2.

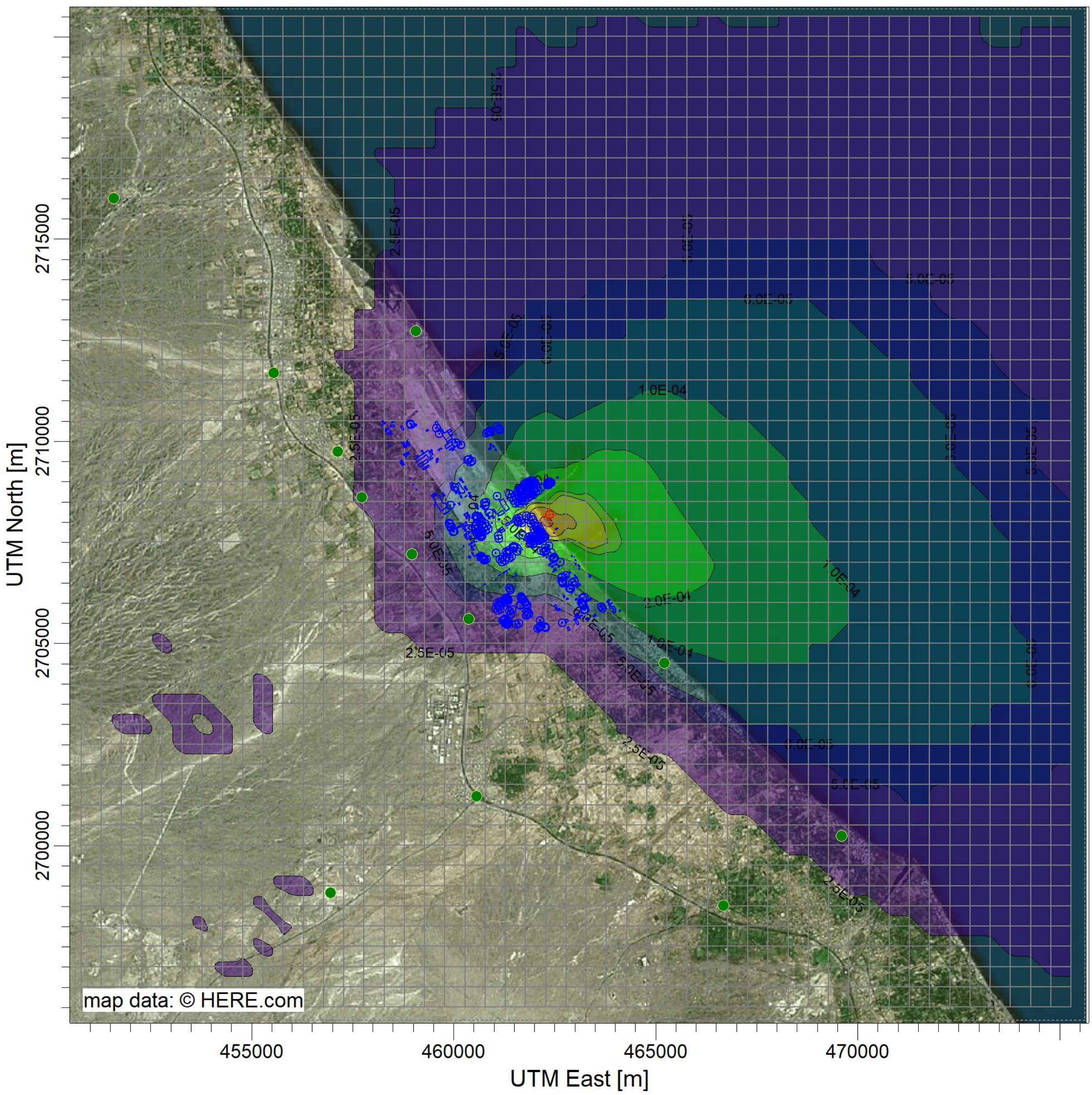
6 Appendix A: Sensitive Receptors Locations and TOTAL LNG Plant

7 Appendix B: 2012 – 2019 wind rose



PROJECT TITLE:

TOTAL LNG Benzene 1 yr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 8 YEARS FOR SOURCE GROUP: ALL ug/m^3

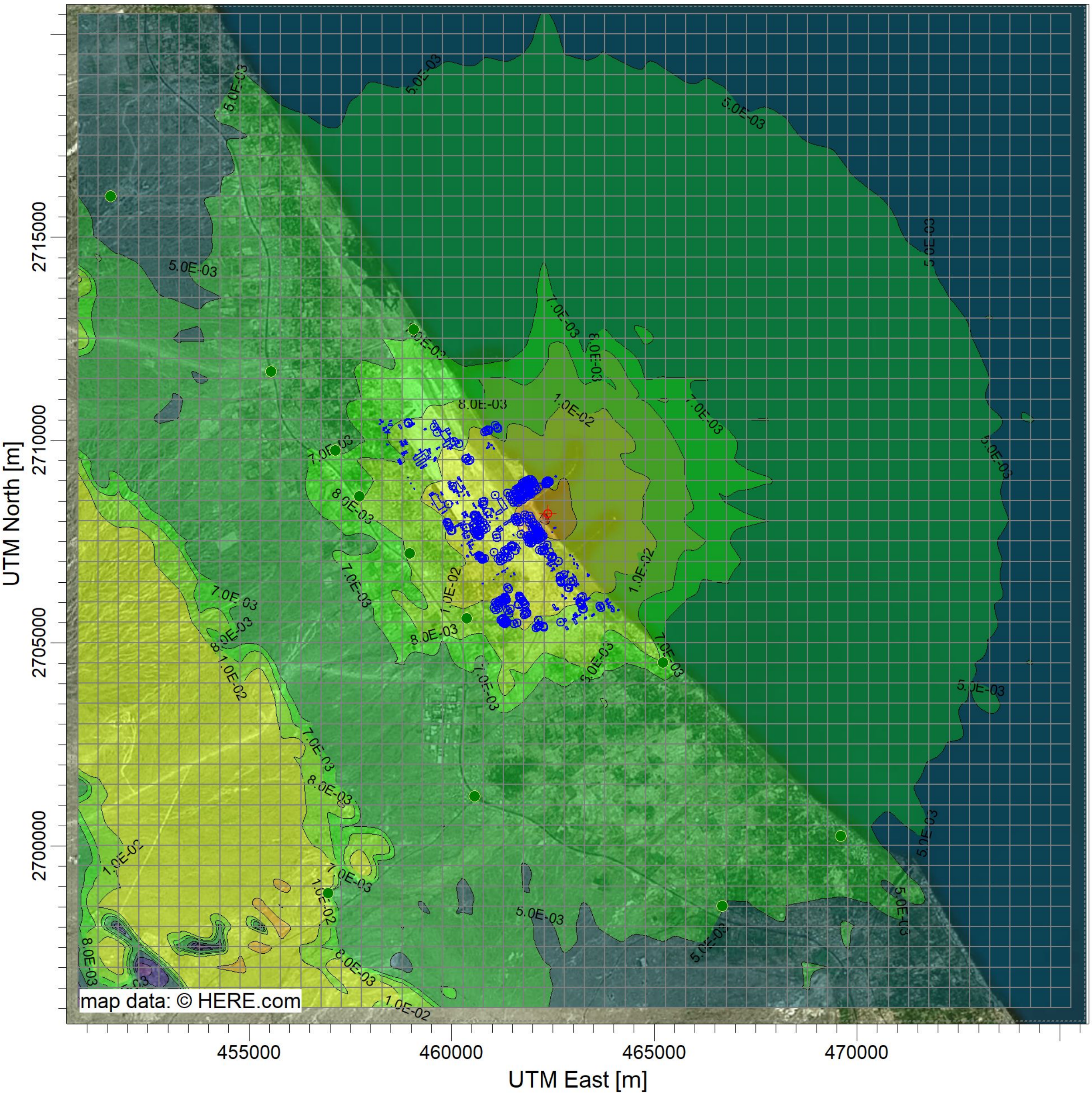
Max: 2.5E-03 [ug/m^3] at (462281.06, 2708010.90)

2.5E-05 5.0E-05 6.0E-05 1.0E-04 2.0E-04 5.0E-04 6.0E-04 1.0E-03 2.0E-03 2.5E-03

COMMENTS:	SOURCES:	COMPANY NAME:	
	2		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **2.5E-03 ug/m^3**	DATE: **8/23/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG Benzene 1hr



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 3.2E-02 [ug/m^3] at (462281.06, 2708010.90)

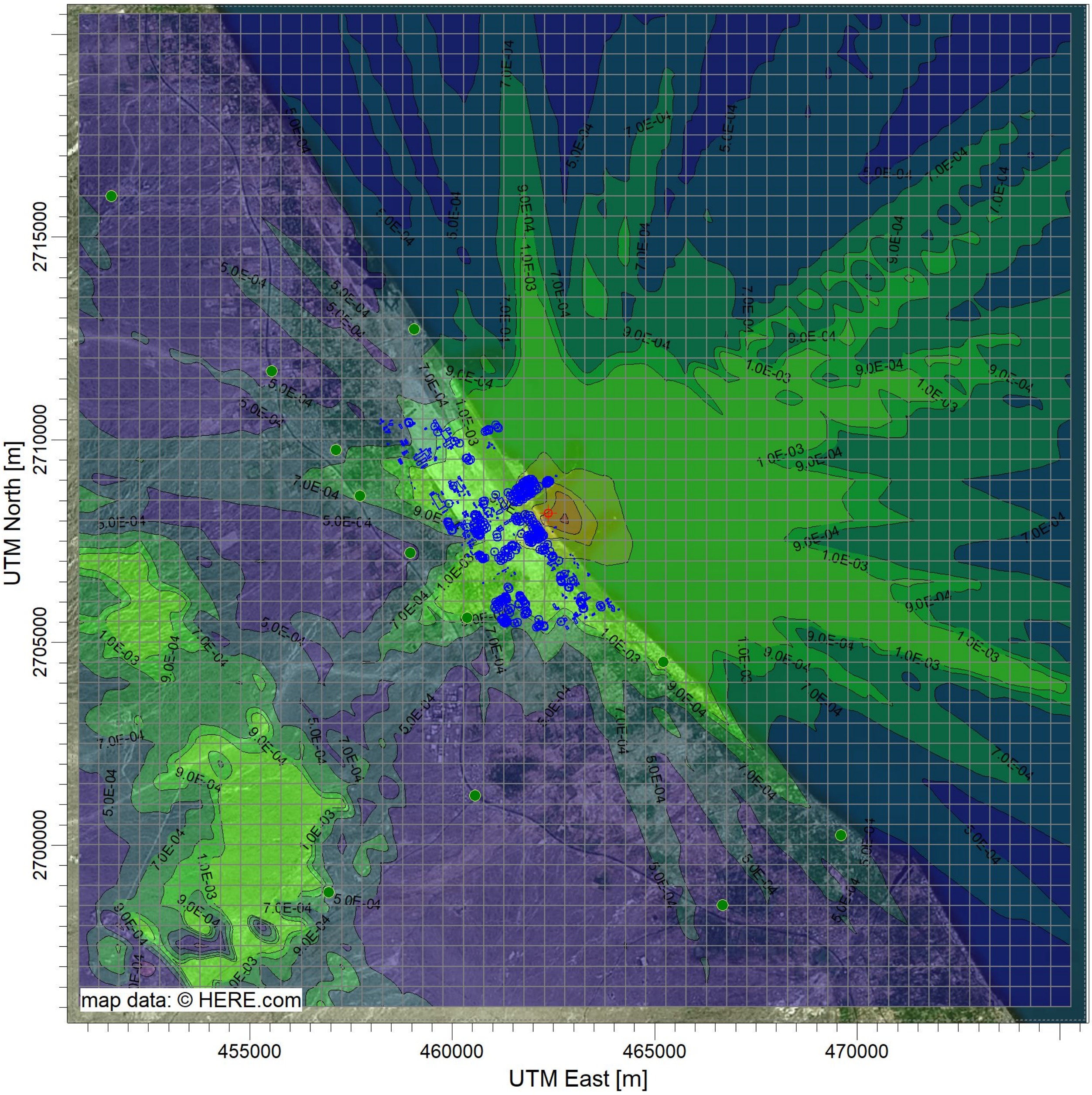
1.7E-03 3.0E-03 4.0E-03 5.0E-03 7.0E-03 8.0E-03 1.0E-02 2.0E-02 3.0E-02 3.2E-02

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **3.2E-02 ug/m^3**	DATE: **8/23/2023**	PROJECT NO.: **TOTAL LNG 2023**

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\2023 07 06 TOTAL C6H6 (Normal)\2023 07 06 TOTAL C6H6 (Normal).isc

PROJECT TITLE:

TOTAL LNG Benzene 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

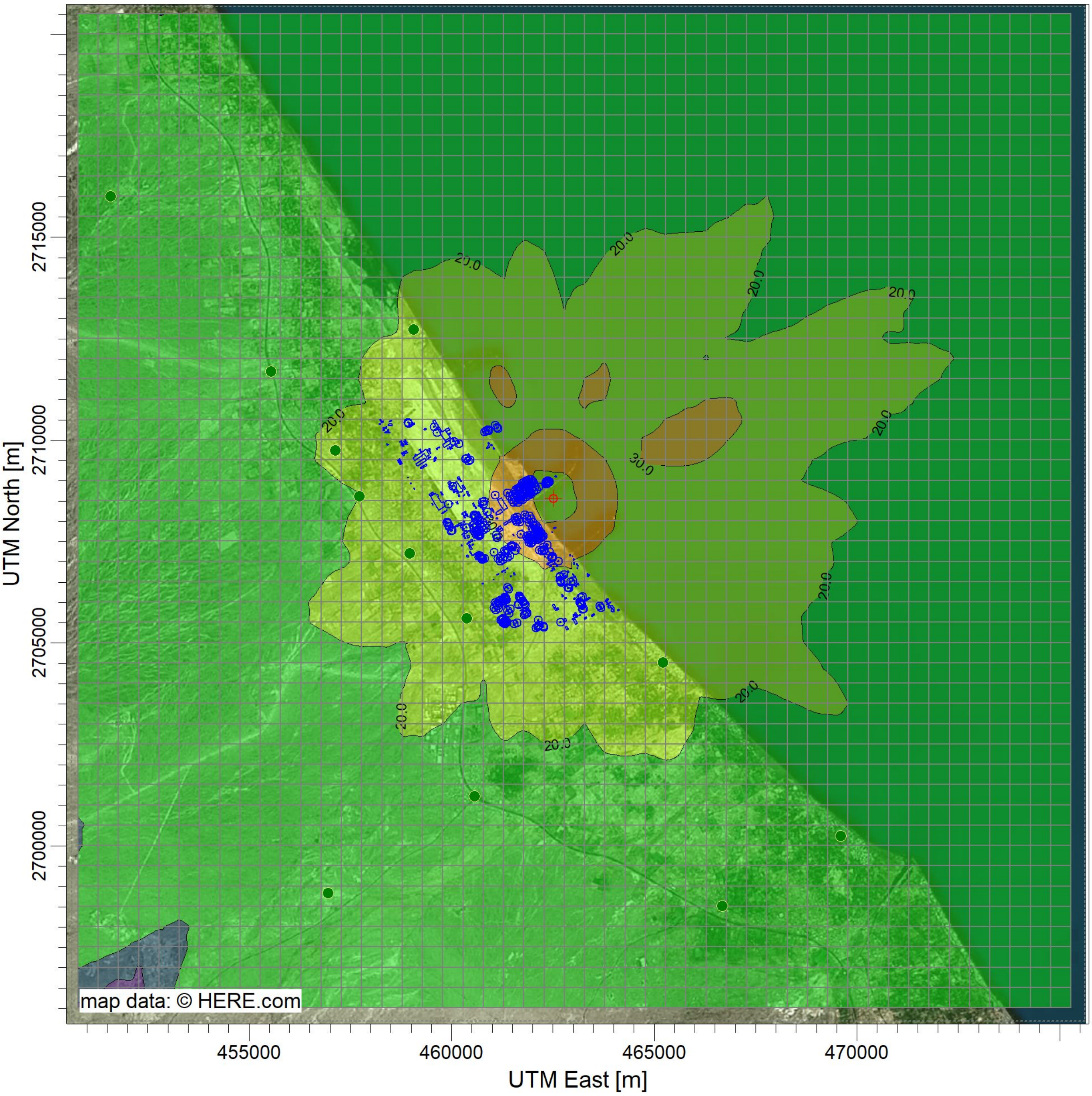
Max: 1.1E-02 [ug/m^3] at (462781.06, 2708010.90)

1.0E-04 2.0E-04 5.0E-04 7.0E-04 9.0E-04 1.0E-03 3.0E-03 5.0E-03 7.0E-03 1.0E-02 1.1E-02

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 ▬ 5 km	
	MAX: **1.1E-02 ug/m^3**	DATE: **8/23/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG CO 1hr - Start up



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

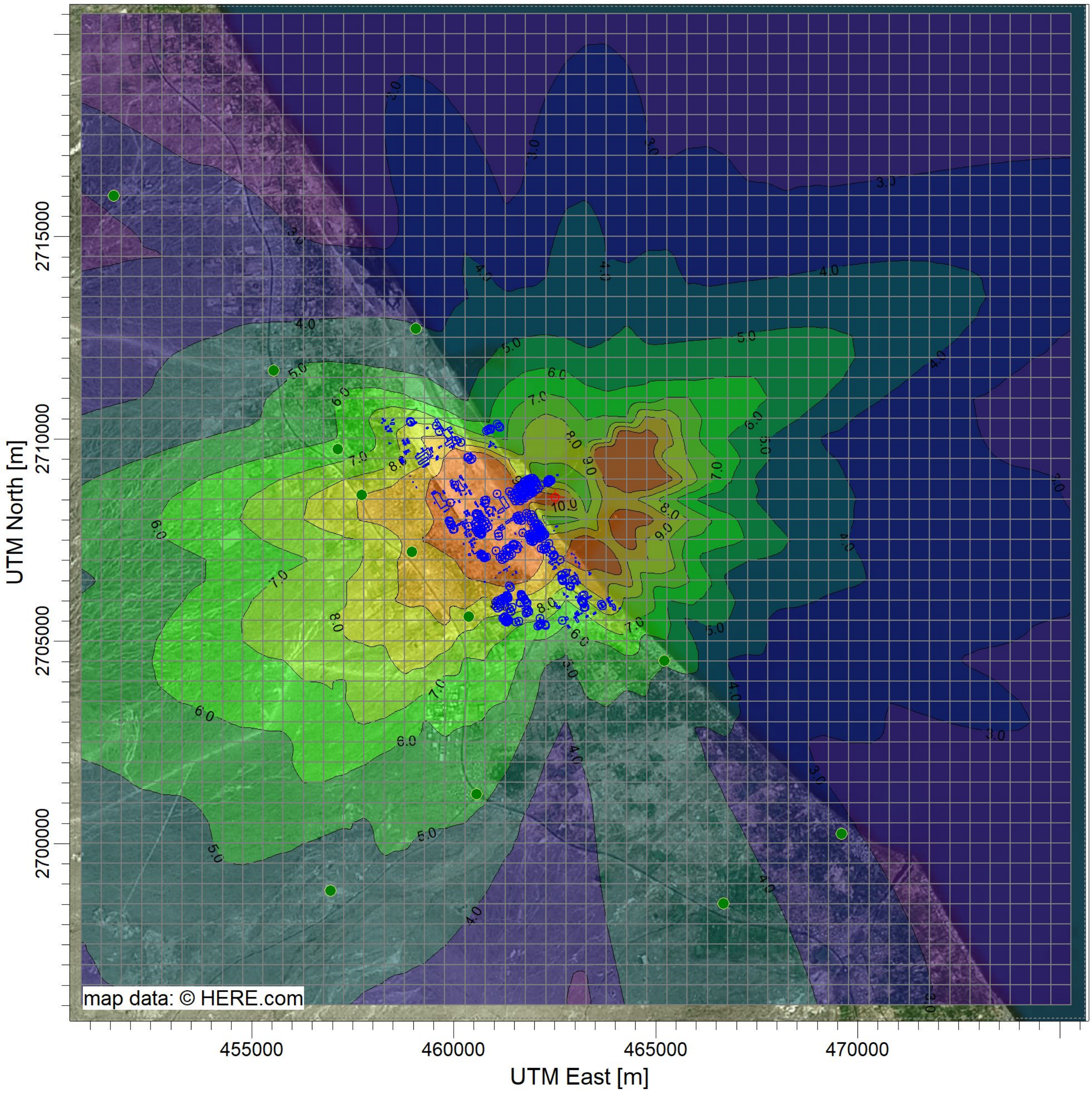
Max: 35.5 [ug/m^3] at (462281.06, 2709510.90)

8.4 9.0 10.0 20.0 30.0 35.5

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **35.5 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG CO 8hr - Start up



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

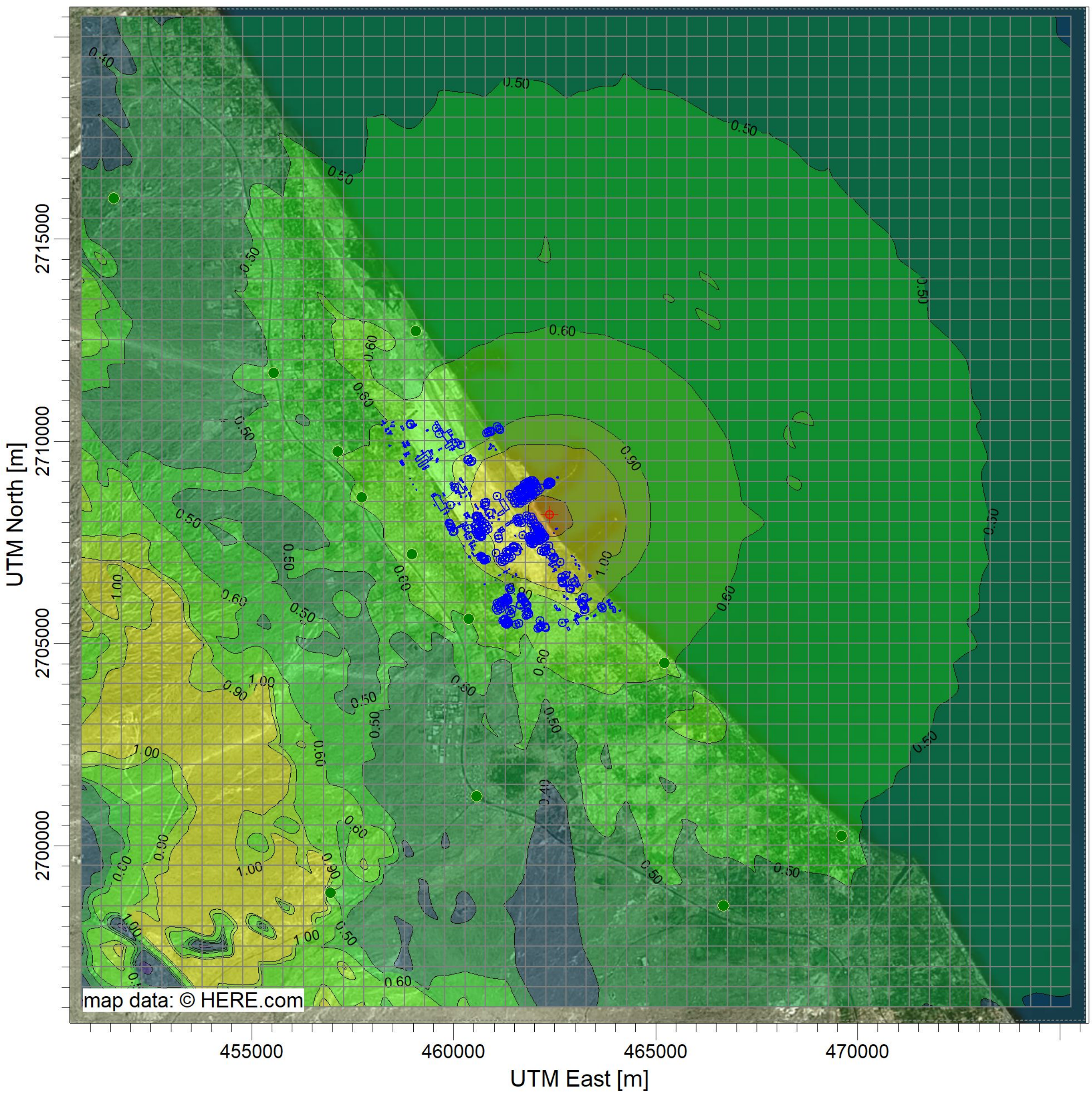
Max: 13.8 [ug/m^3] at (461281.06, 2708010.90)

1.6 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 13.8

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 — 5 km	
	MAX: **13.8 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - Normal 1hr



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

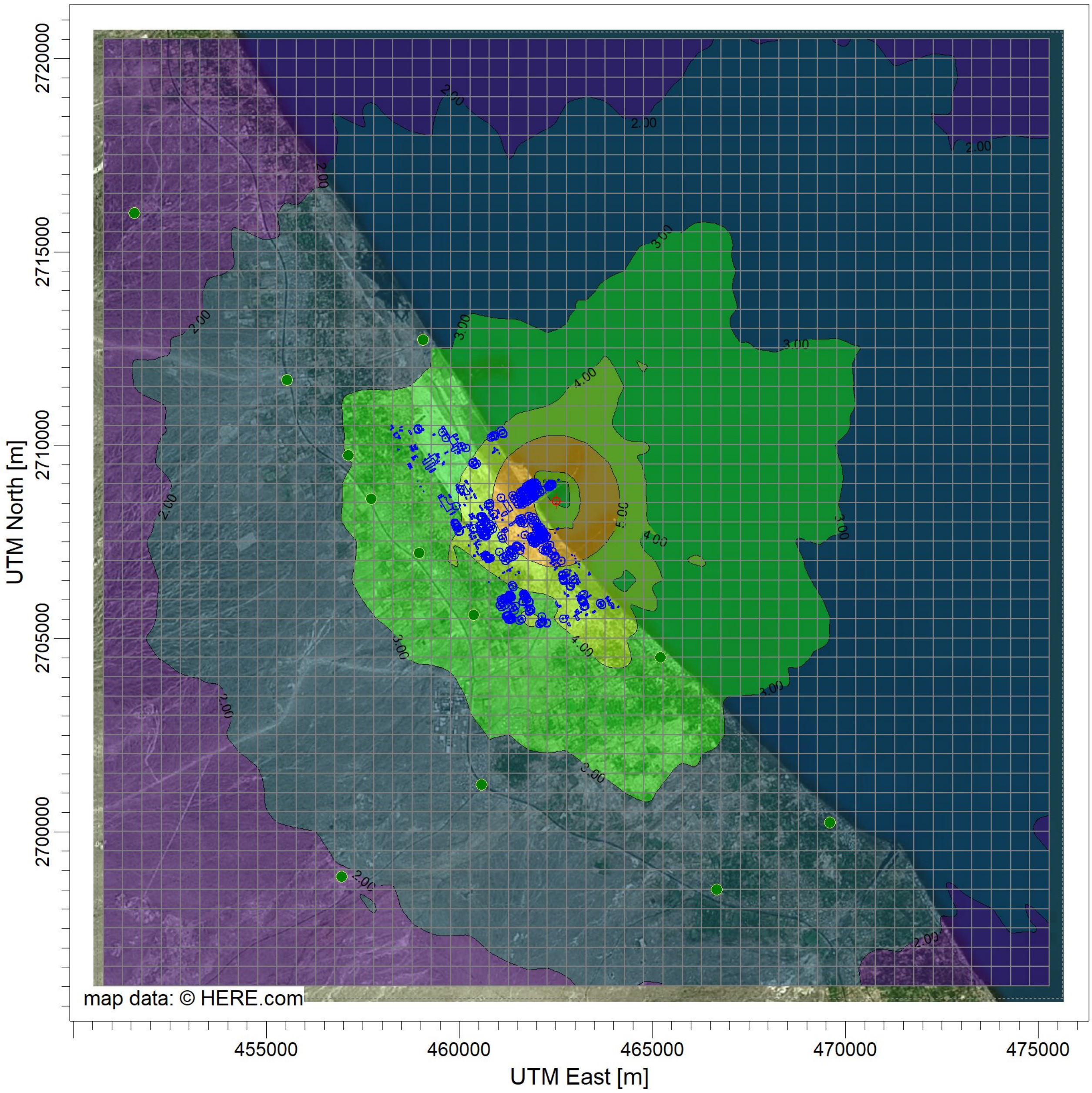
Max: 3.02 [ug/m^3] at (462281.06, 2708010.90)

0.09 | 0.10 | 0.20 | 0.40 | 0.50 | 0.60 | 0.90 | 1.00 | 2.00 | 3.00 | 3.02

COMMENTS:	SOURCES:	COMPANY NAME:	
	2		
	RECEPTORS:	MODELER:	
	2512		
	OUTPUT TYPE:	SCALE: 1:162,914	
	Concentration	0 — 5 km	
	MAX:	DATE:	PROJECT NO.:
	3.02 ug/m^3	**7/8/2023**	**TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - 1hr Start-up



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

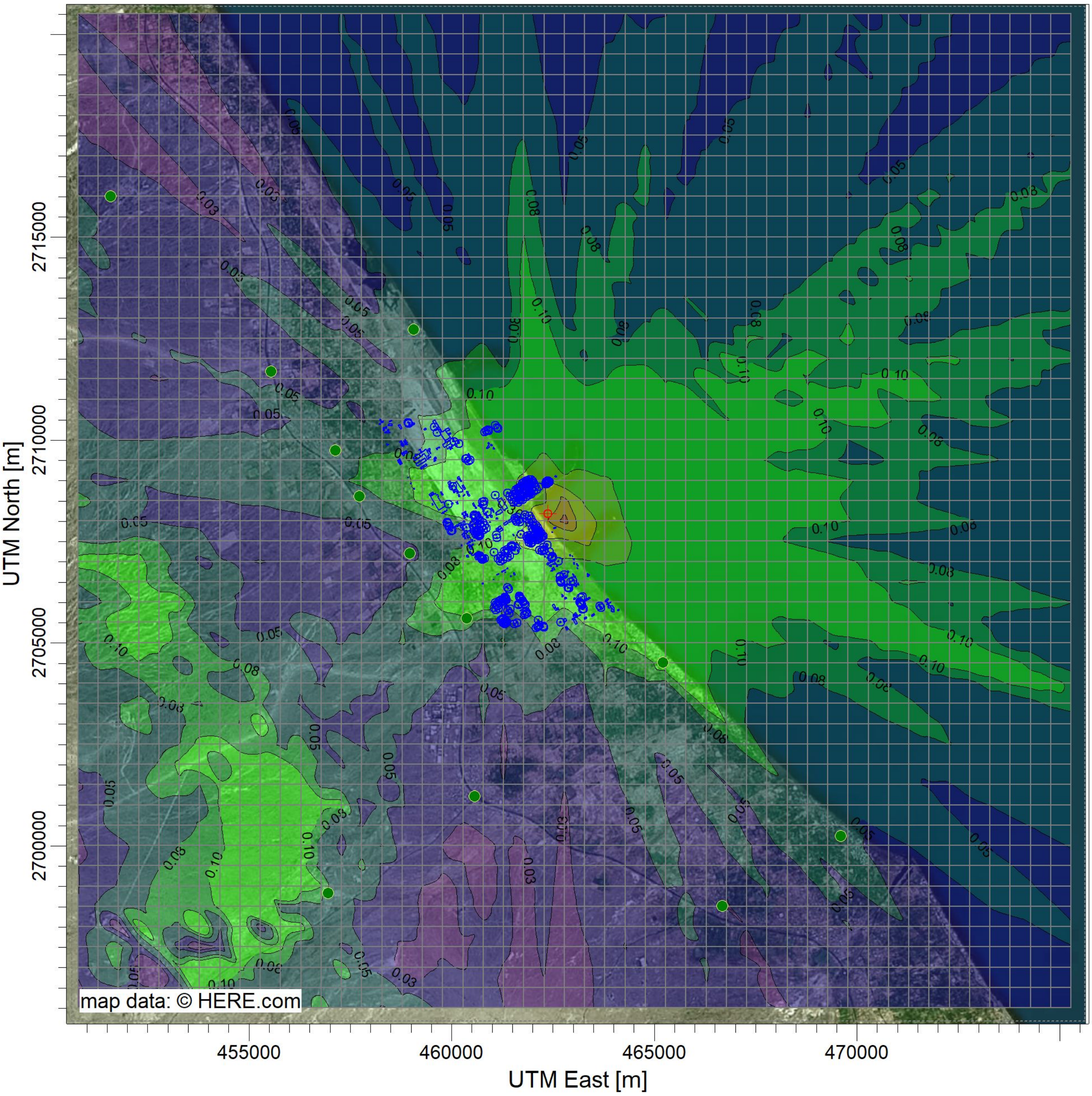
Max: 5.88 [ug/m^3] at (462281.06, 2707510.90)

1.40 | 2.00 | 3.00 | 4.00 | 5.00 | 5.88

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:170,497 0 5 km	
	MAX: **5.88 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - Normal 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

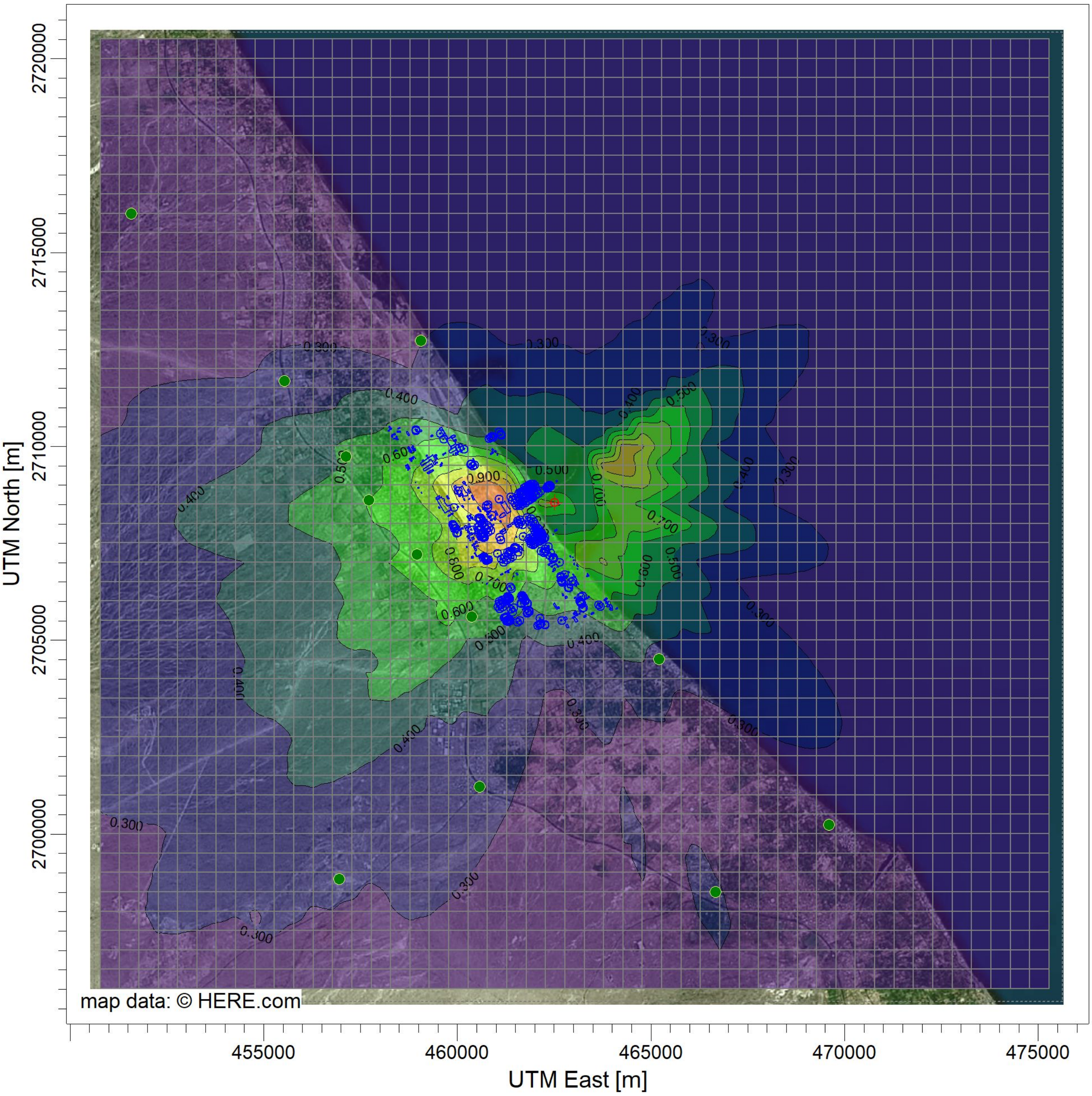
Max: 1.08 [ug/m^3] at (462781.06, 2708010.90)

0.01 0.03 0.05 0.08 0.10 0.30 0.50 0.80 1.00 1.08

COMMENTS:	SOURCES: 2	COMPANY NAME:	
	RECEPTORS: 2512	MODELER:	
	OUTPUT TYPE: Concentration	SCALE: 1:162,914 (0 — 5 km)	
	MAX: 1.08 ug/m^3	DATE: 7/8/2023	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

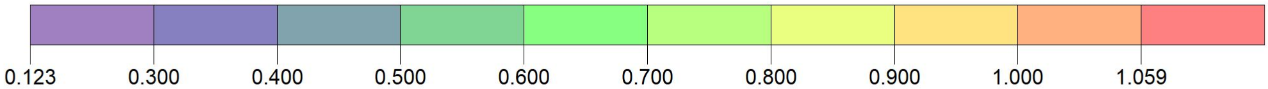
TOTAL LNG NO2 - 24hr Start-up



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

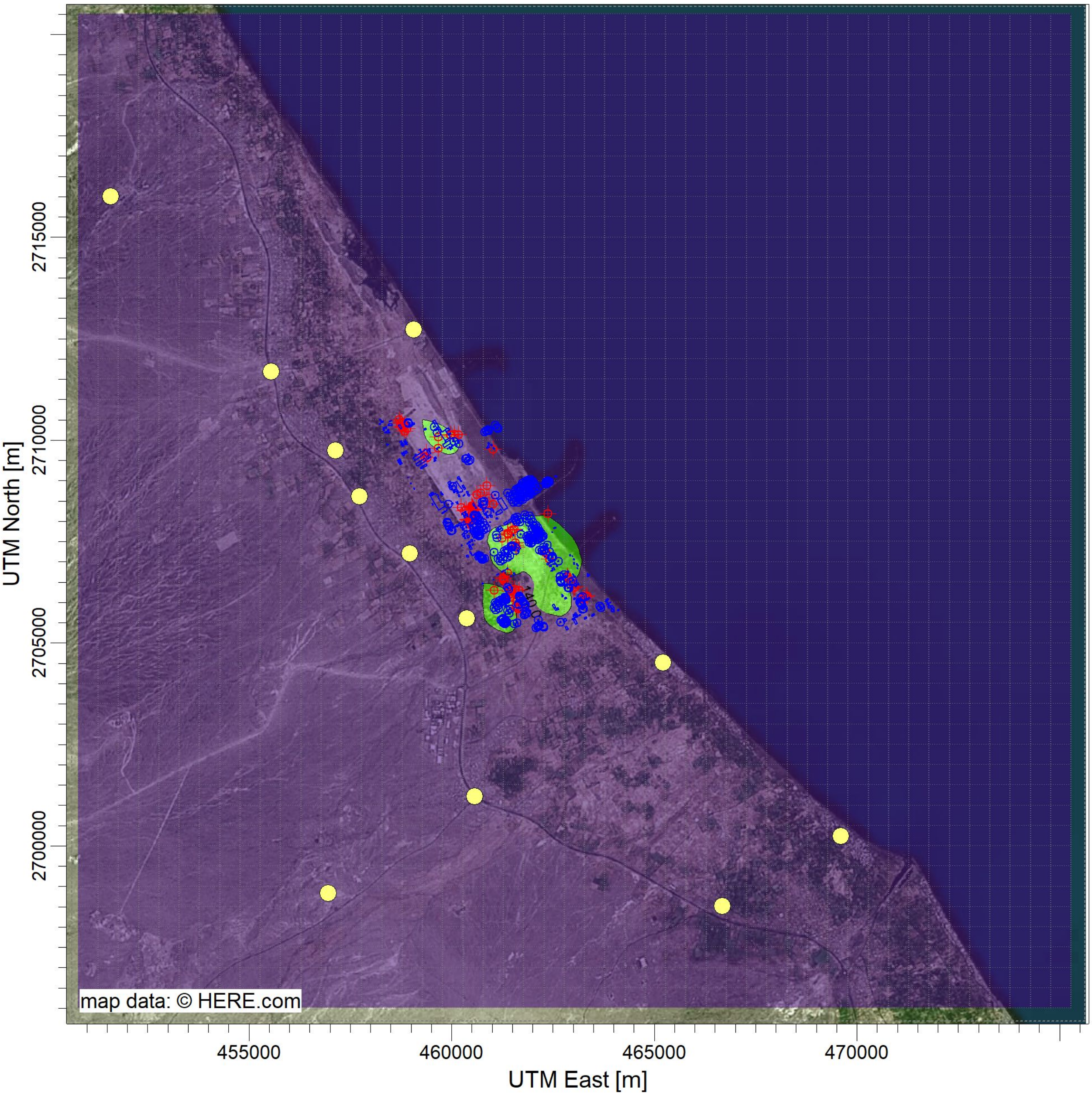
Max: 1.059 [ug/m^3] at (460781.06, 2708510.90)



COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:170,497 0 — 5 km	
	MAX: **1.059 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

PM Currant operational (SPF) + TOTAL LNG normal operation µg/m3 24hr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 6 YEARS FOR SOURCE GROUP: ALL ug/m^3

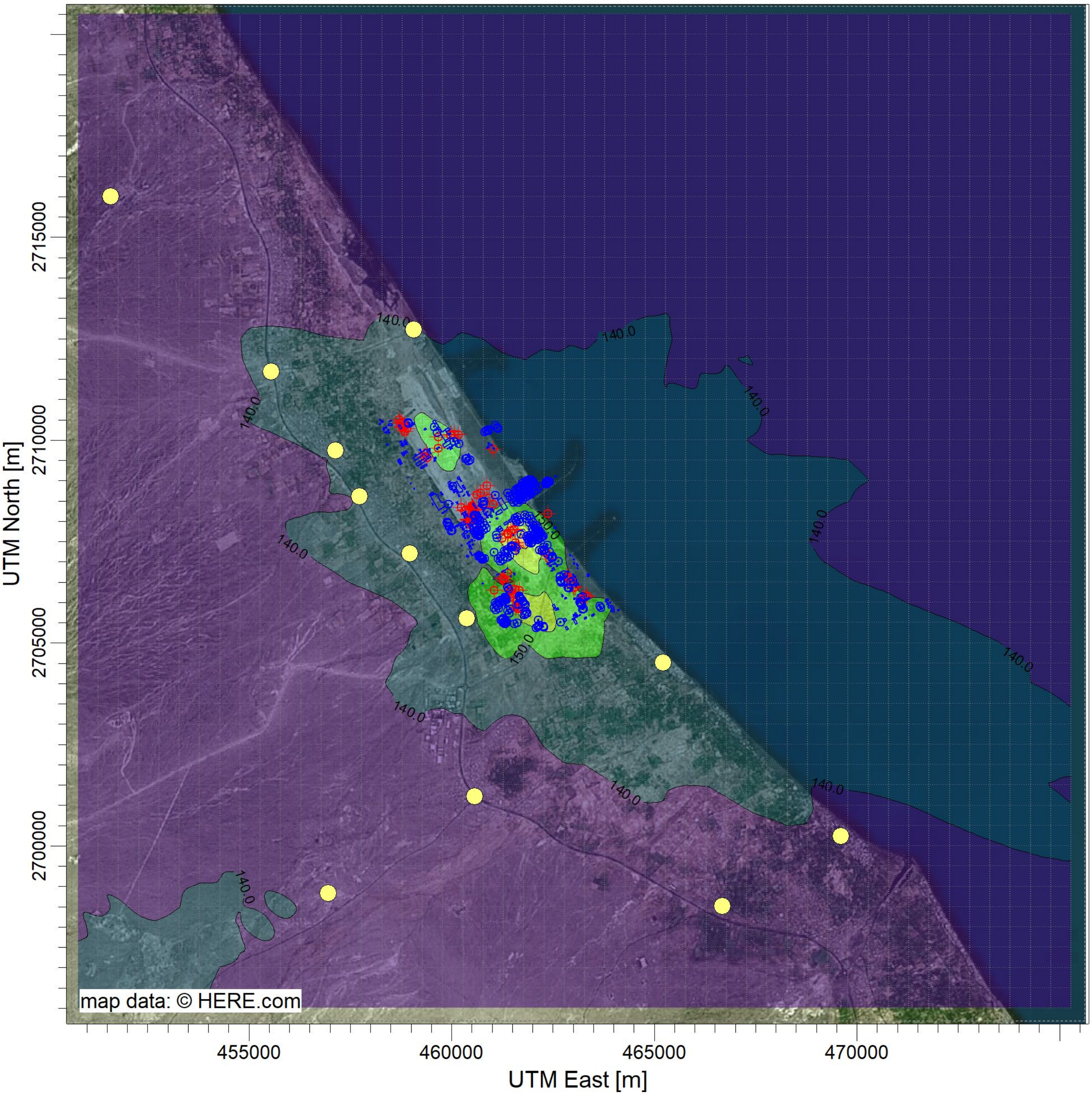
Max: 145.8 [ug/m^3] at (461781.06, 2707510.90)

134.5 140.0 145.8

COMMENTS:	SOURCES: **82**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **145.8 ug/m^3**	DATE: **8/24/2023**	PROJECT NO.:

PROJECT TITLE:

PM Currant operational (SPF) + TOTAL LNG normal operation µg/m3 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

Max: 173.8 [ug/m^3] at (461781.06, 2707510.90)

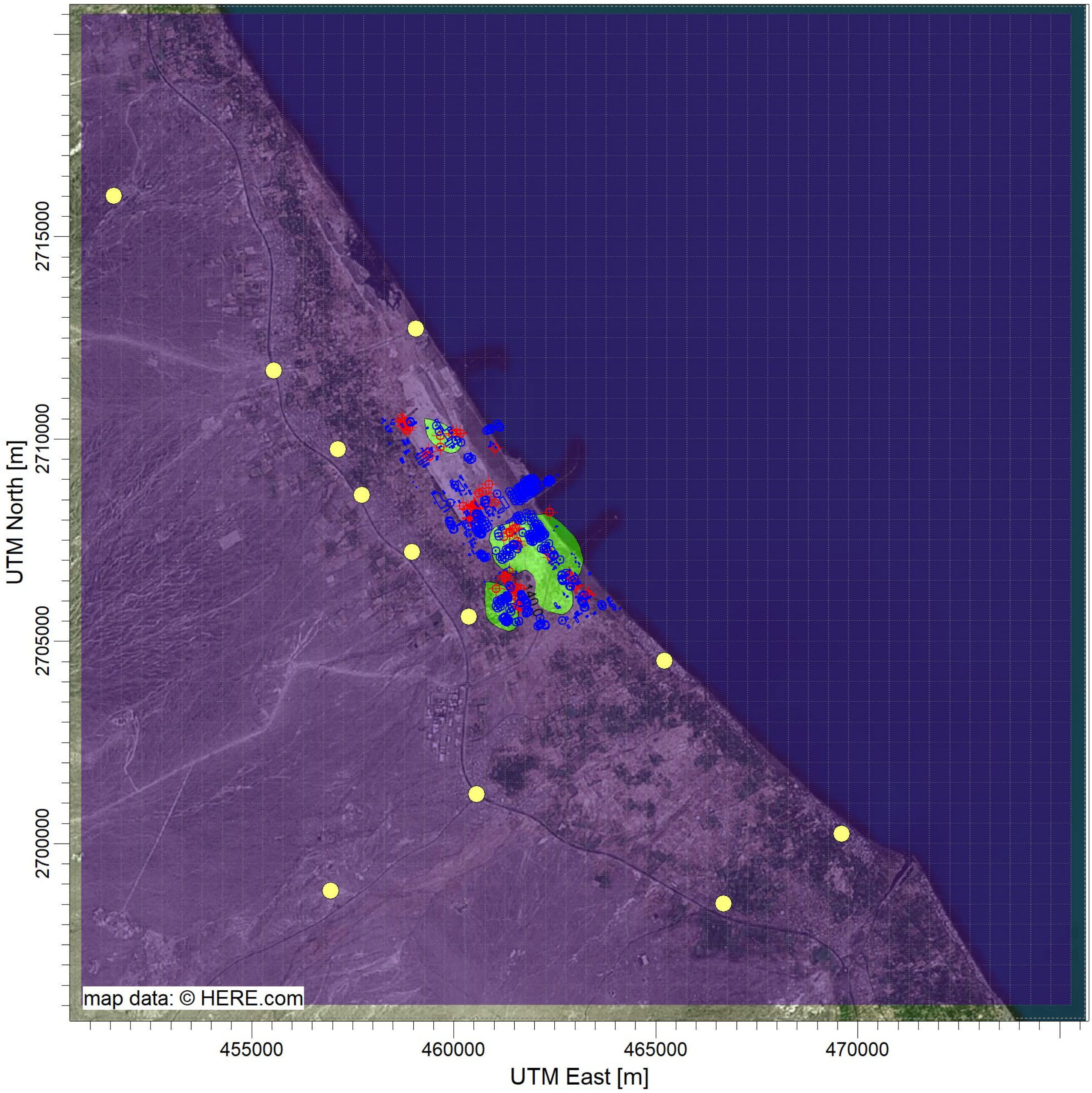
ug/m^3

136.1 | 140.0 | 150.0 | 160.0 | 170.0 | 173.8

COMMENTS:	SOURCES: **82**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 (0 — 5 km)	
	MAX: **173.8 ug/m^3**	DATE: **8/24/2023**	PROJECT NO.:

PROJECT TITLE:

PM Currant operational (SPF) + TOTAL LNG normal operation µg/m3 1yr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 6 YEARS FOR SOURCE GROUP: ALL   ug/m^3

Max: 145.8 [ug/m^3] at (461781.06, 2707510.90)

134.5   140.0   145.8

COMMENTS:

SOURCES:

82

COMPANY NAME:

RECEPTORS:

2512

MODELER:

OUTPUT TYPE:

Concentration

SCALE: 1:162,914

0 5 km

MAX:

145.8 ug/m^3

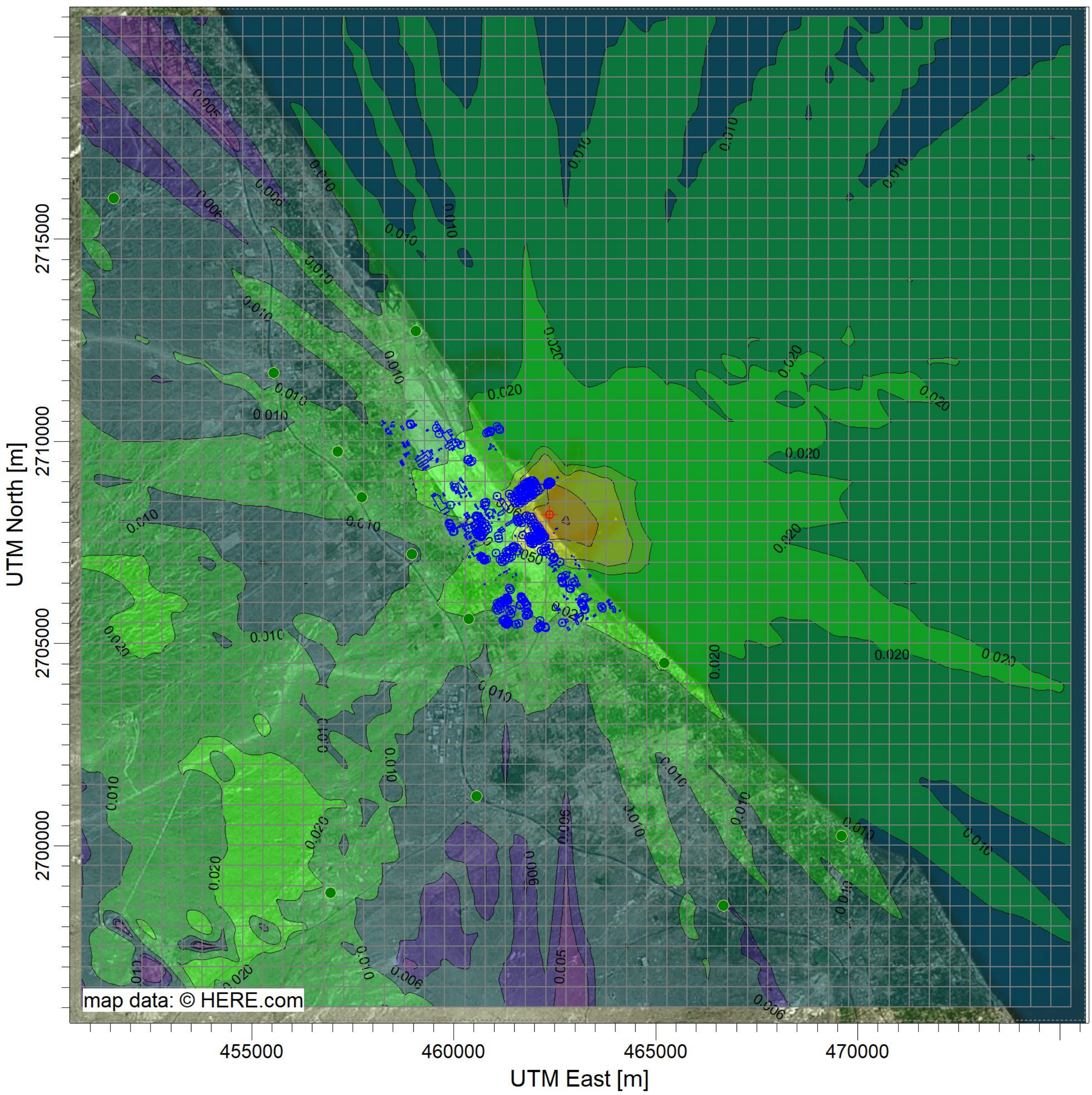
DATE:

9/8/2023

PROJECT NO.:

PROJECT TITLE:

TOTAL LNG PM - 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

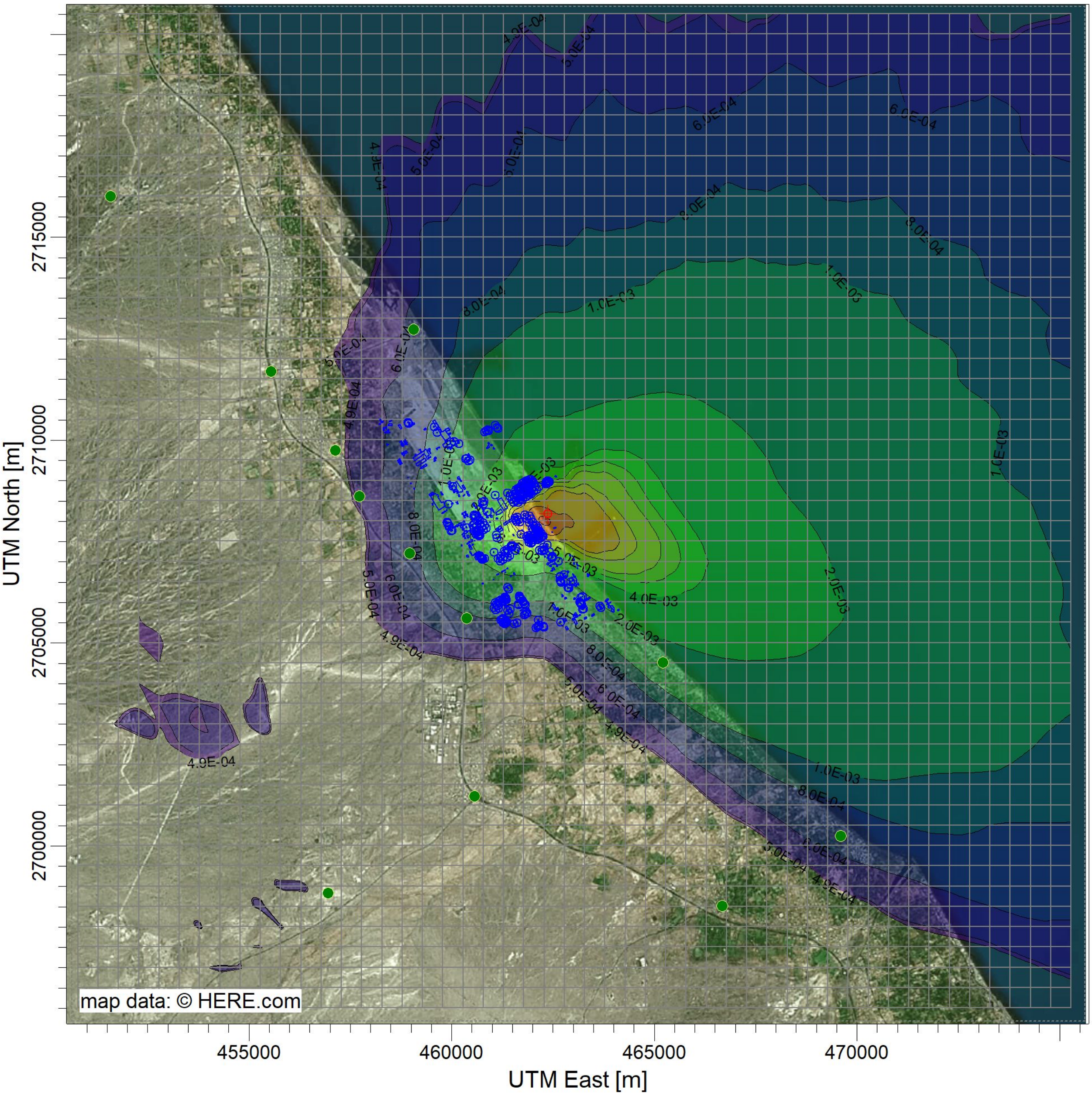
Max: 0.215 [ug/m^3] at (462781.06, 2708010.90)

0.002 0.005 0.006 0.010 0.020 0.050 0.060 0.100 0.200 0.215

COMMENTS:	SOURCES: **1**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **0.215 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG PM - 1yr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 8 YEARS FOR SOURCE GROUP: ALL ug/m^3

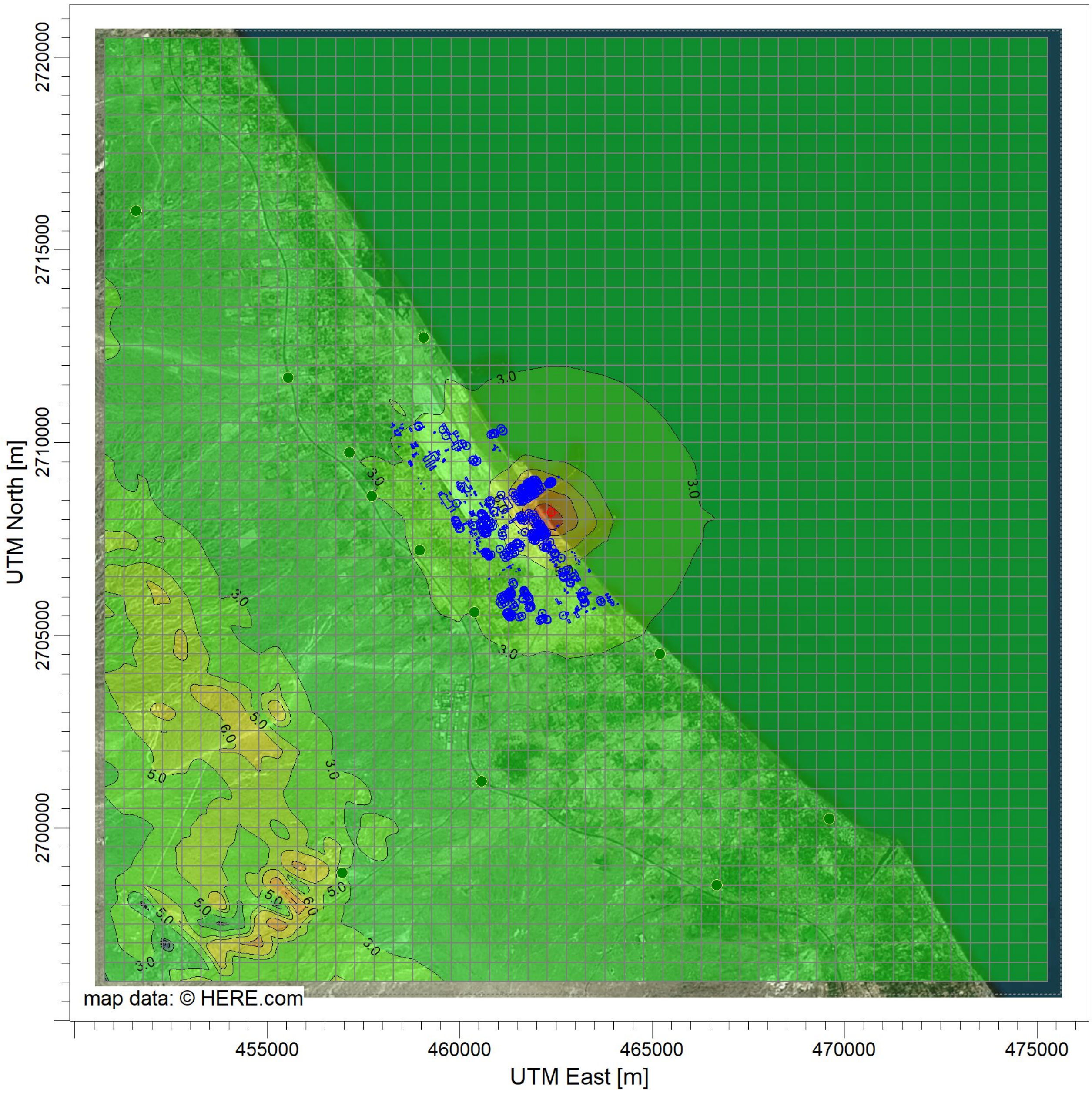
Max: 5.0E-02 [ug/m^3] at (462281.06, 2708010.90)

4.9E-04 5.0E-04 6.0E-04 8.0E-04 1.0E-03 2.0E-03 4.0E-03 5.0E-03 6.0E-03 8.0E-03 1.0E-02 2.0E-02 4.0E-02 5.0E-02

COMMENTS:	SOURCES: **1**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 (0 — 5 km)	
	MAX: **5.0E-02 ug/m^3**	DATE: **8/23/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG SO2 - 1hr



PLOT FILE OF HIGH 4TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 13.2 [ug/m^3] at (462281.06, 2708010.90)

0.4 0.5 0.6 0.8 1.0 3.0 5.0 6.0 8.0 10.0 13.2

COMMENTS:

SOURCES:

1

COMPANY NAME:

RECEPTORS:

2512

MODELER:

OUTPUT TYPE:

Concentration

SCALE: 1:171,058

0 5 km

MAX:

13.2 ug/m^3

DATE:

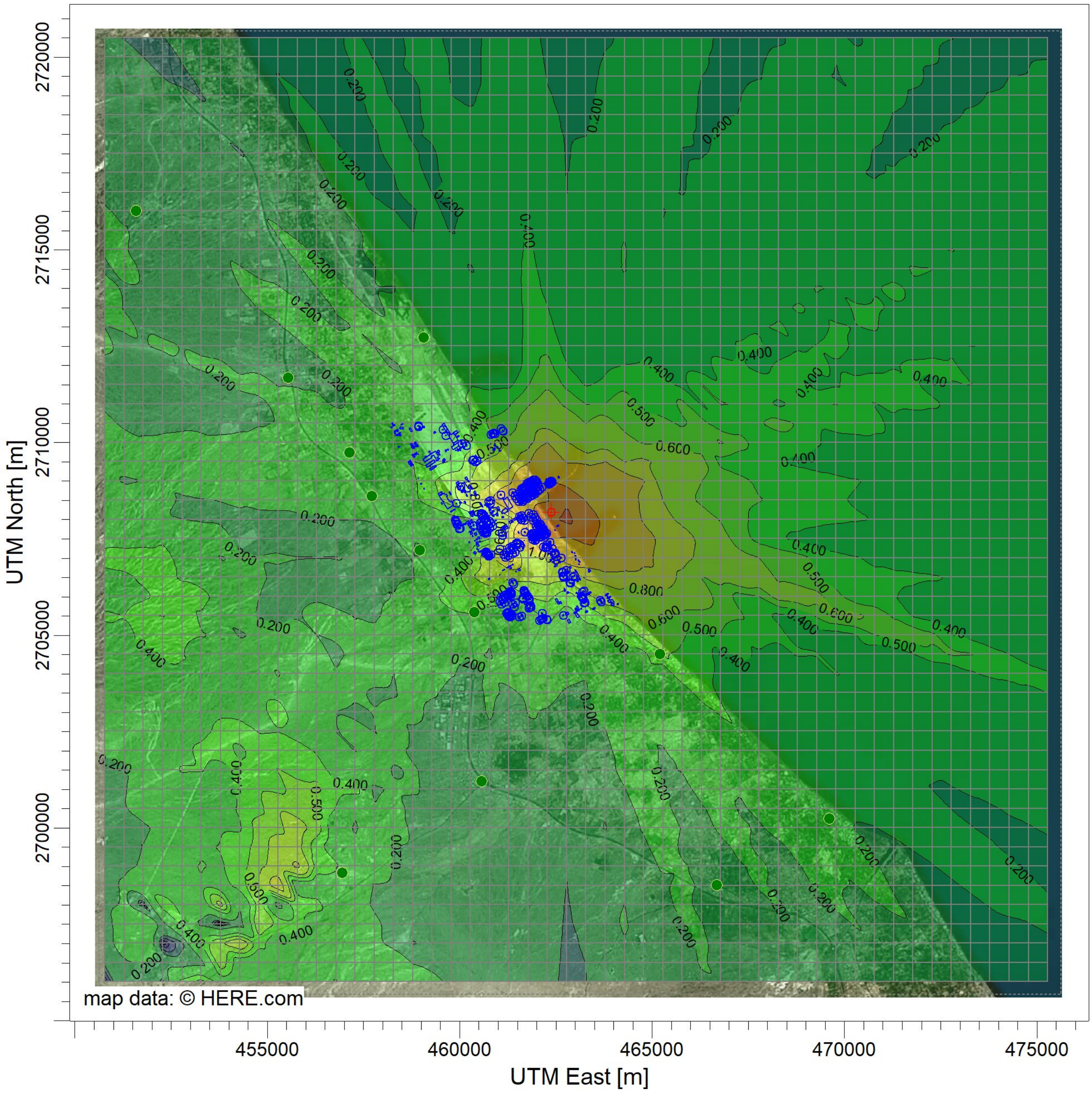
7/8/2023

PROJECT NO.:

TOTAL LNG 2023

PROJECT TITLE:

TOTAL LNG SO2 - 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

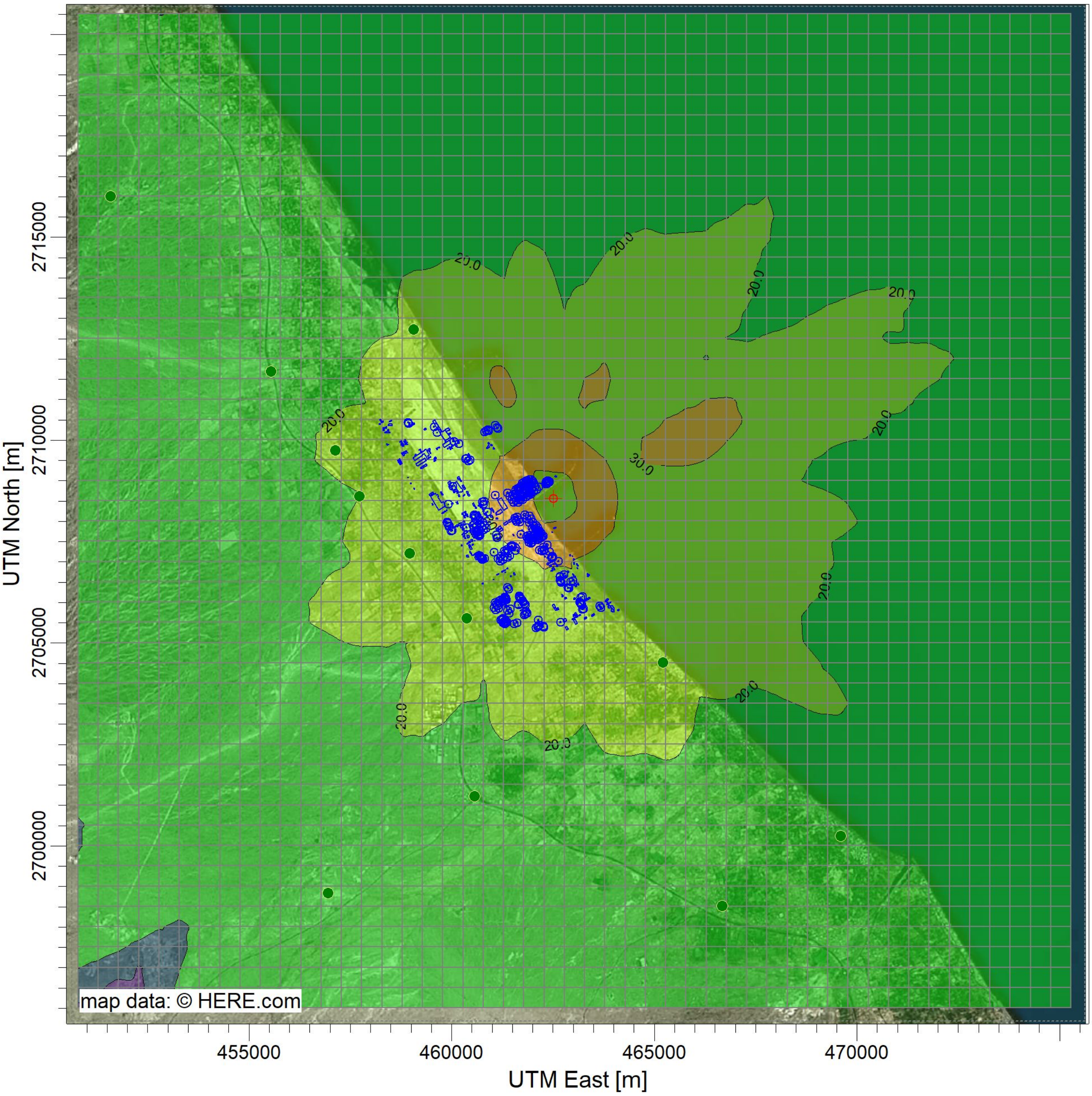
Max: 4.587 [ug/m^3] at (462781.06, 2708010.90)

0.046	0.050	0.060	0.080	0.100	0.200	0.400	0.500	0.600	0.800	1.000	2.000	4.000	4.587

COMMENTS:	SOURCES:	COMPANY NAME:	
	1		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:171,058 0 — 5 km	
	MAX: **4.587 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG CO 1hr - Start up



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

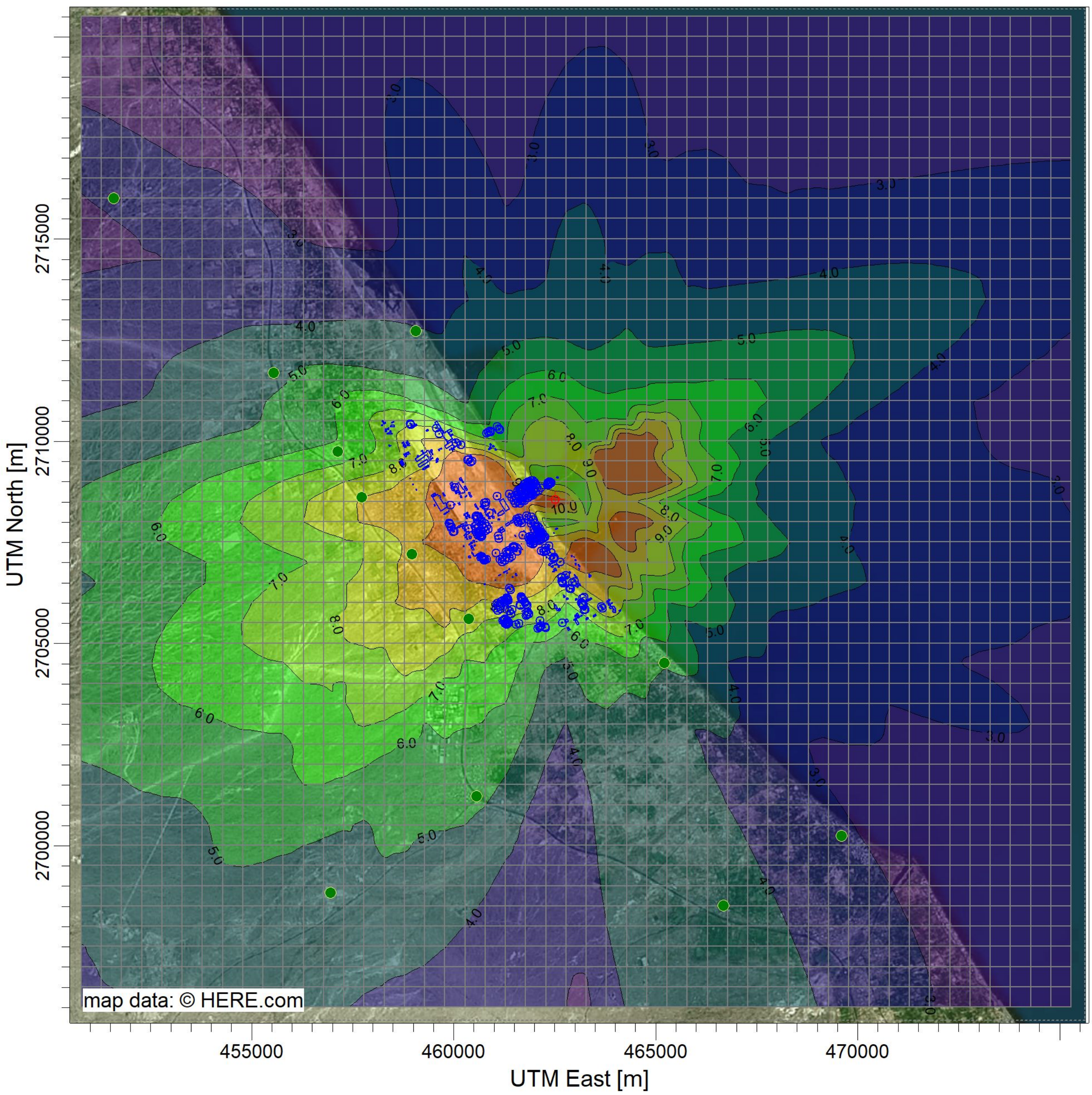
Max: 35.5 [ug/m^3] at (462281.06, 2709510.90)

8.4 | 9.0 | 10.0 | 20.0 | 30.0 | 35.5

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 — 5 km	
	MAX: **35.5 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG CO 8hr - Start up



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

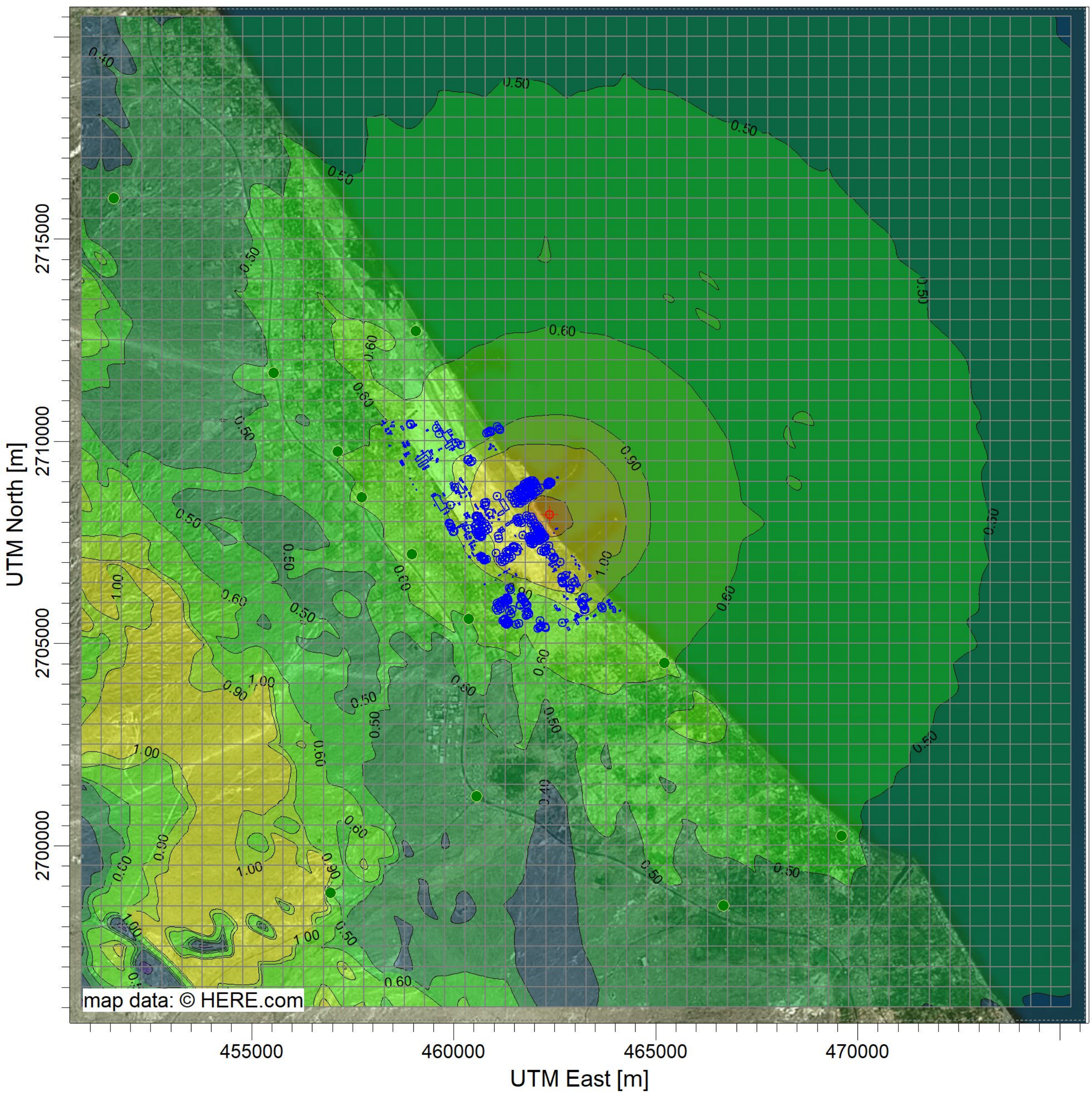
Max: 13.8 [ug/m^3] at (461281.06, 2708010.90)

1.6 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 13.8

COMMENTS:	SOURCES:	COMPANY NAME:	
	2		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **13.8 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - Normal 1hr



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

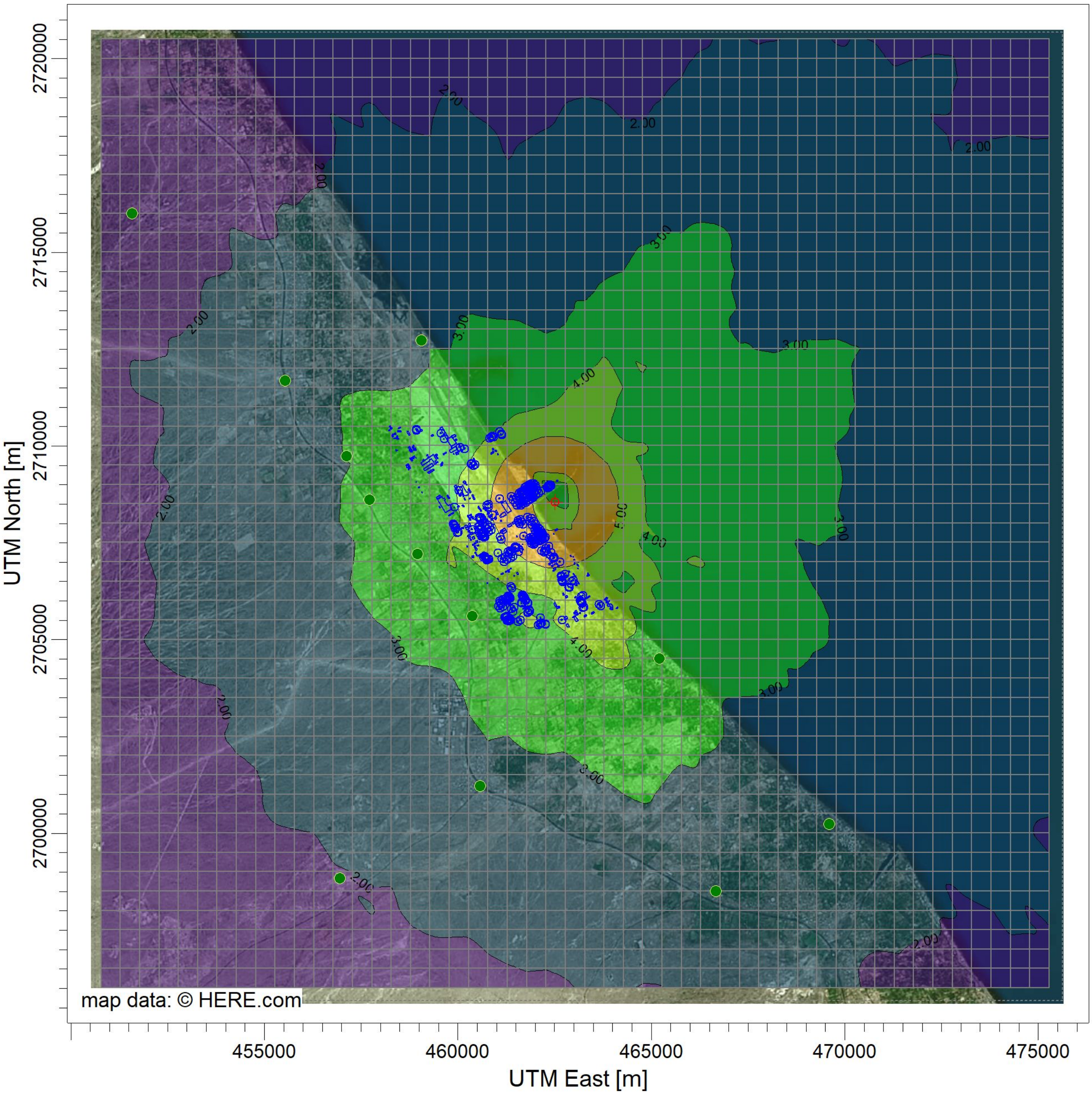
Max: 3.02 [ug/m^3] at (462281.06, 2708010.90)

0.09 0.10 0.20 0.40 0.50 0.60 0.90 1.00 2.00 3.00 3.02

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 — 5 km	
	MAX: **3.02 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - 1hr Start-up



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

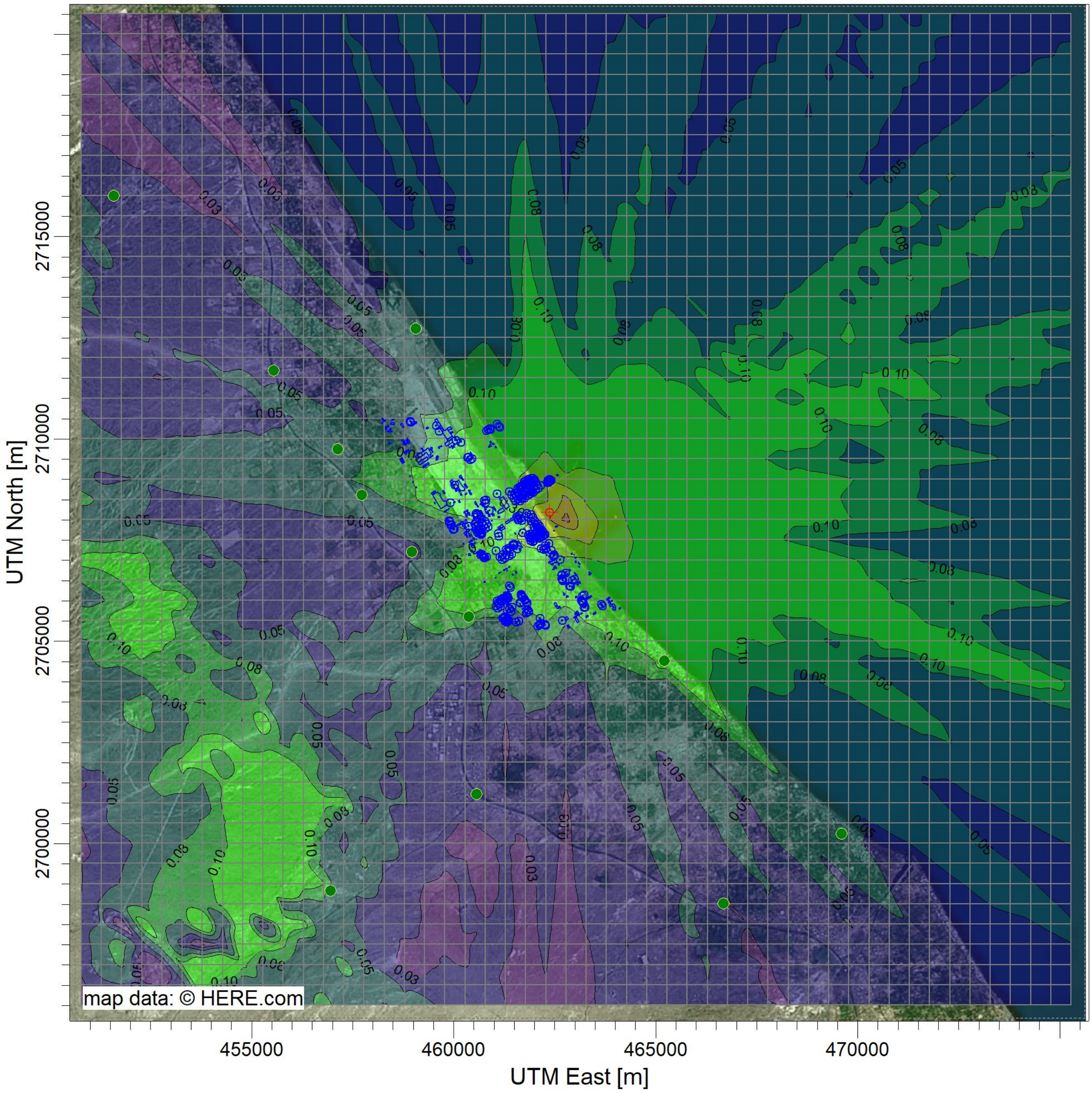
Max: 5.88 [ug/m^3] at (462281.06, 2707510.90)

1.40 | 2.00 | 3.00 | 4.00 | 5.00 | 5.88

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:170,497 0 5 km	
	MAX: **5.88 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - Normal 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

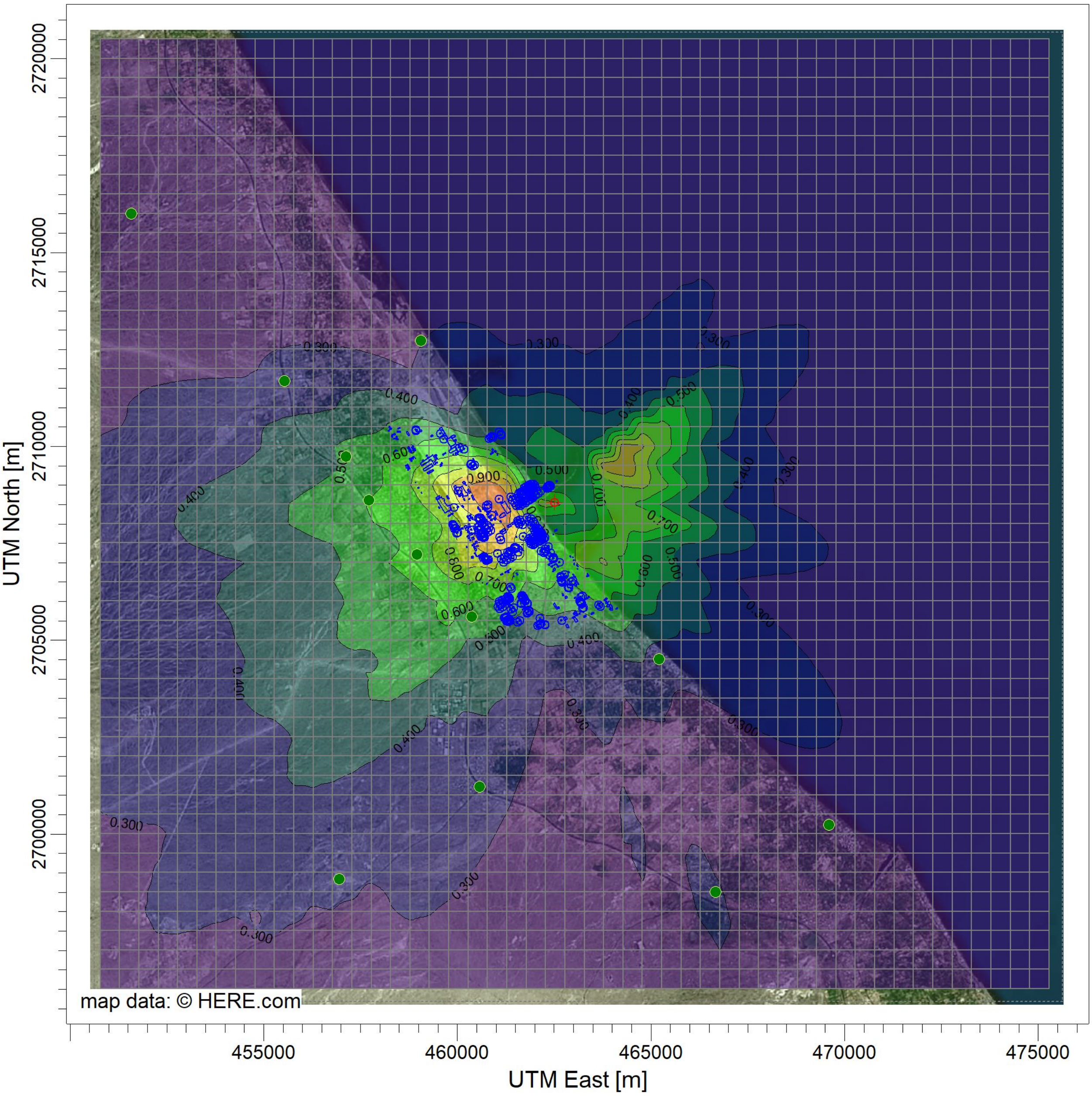
Max: 1.08 [ug/m^3] at (462781.06, 2708010.90)

0.01 0.03 0.05 0.08 0.10 0.30 0.50 0.80 1.00 1.08

COMMENTS:	SOURCES: **2**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **1.08 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG NO2 - 24hr Start-up



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 1.059 [ug/m^3] at (460781.06, 2708510.90)

0.123 0.300 0.400 0.500 0.600 0.700 0.800 0.900 1.000 1.059

COMMENTS:

SOURCES: **2**

COMPANY NAME:

RECEPTORS: **2512**

MODELER:

OUTPUT TYPE: **Concentration**

SCALE: 1:170,497

0 5 km

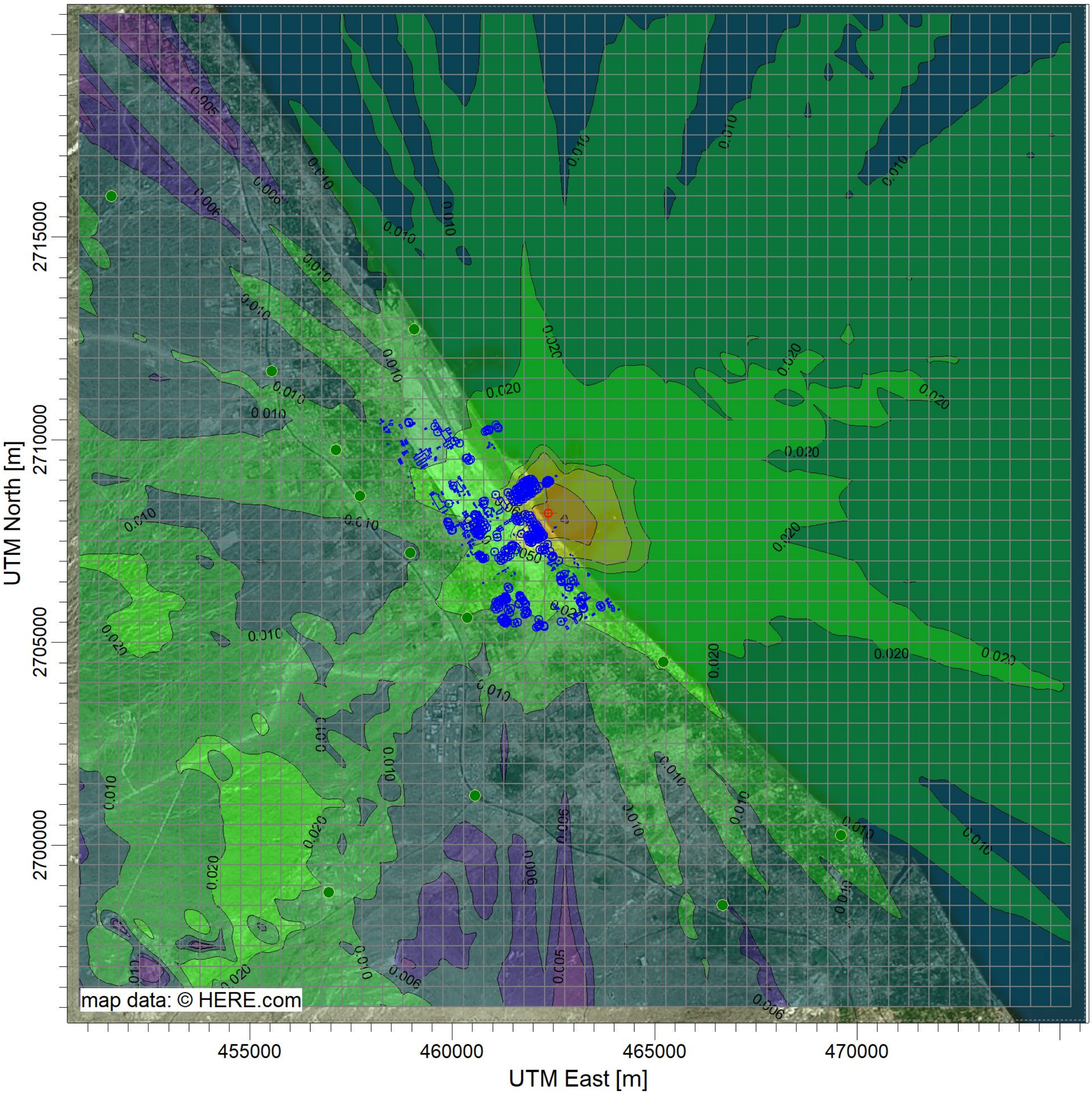
MAX: **1.059 ug/m^3**

DATE: **7/8/2023**

PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG PM - 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

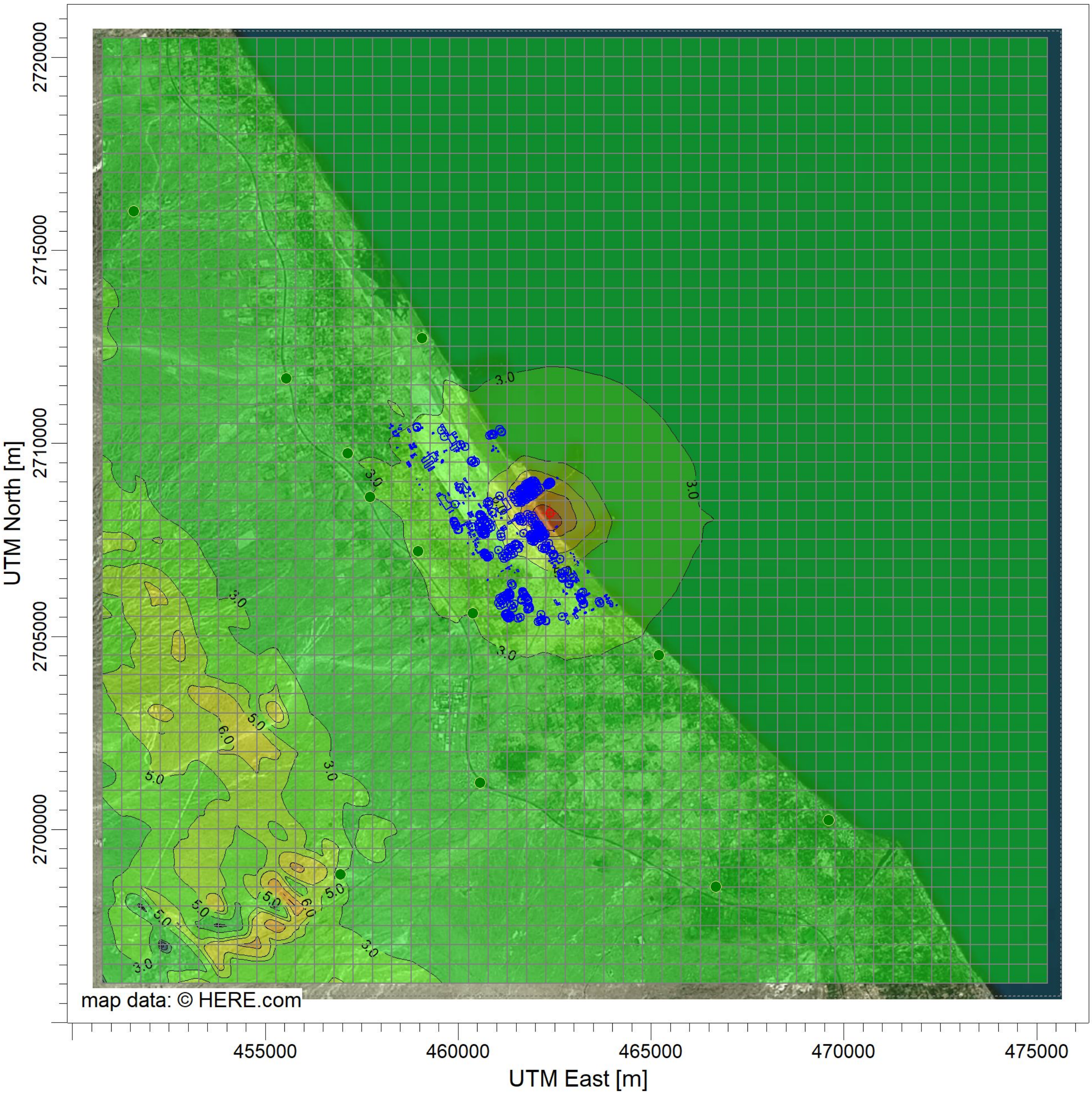
Max: 0.215 [ug/m^3] at (462781.06, 2708010.90)

0.002 0.005 0.006 0.010 0.020 0.050 0.060 0.100 0.200 0.215

COMMENTS:	SOURCES: **1**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **0.215 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG SO2 - 1hr



PLOT FILE OF HIGH 4TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

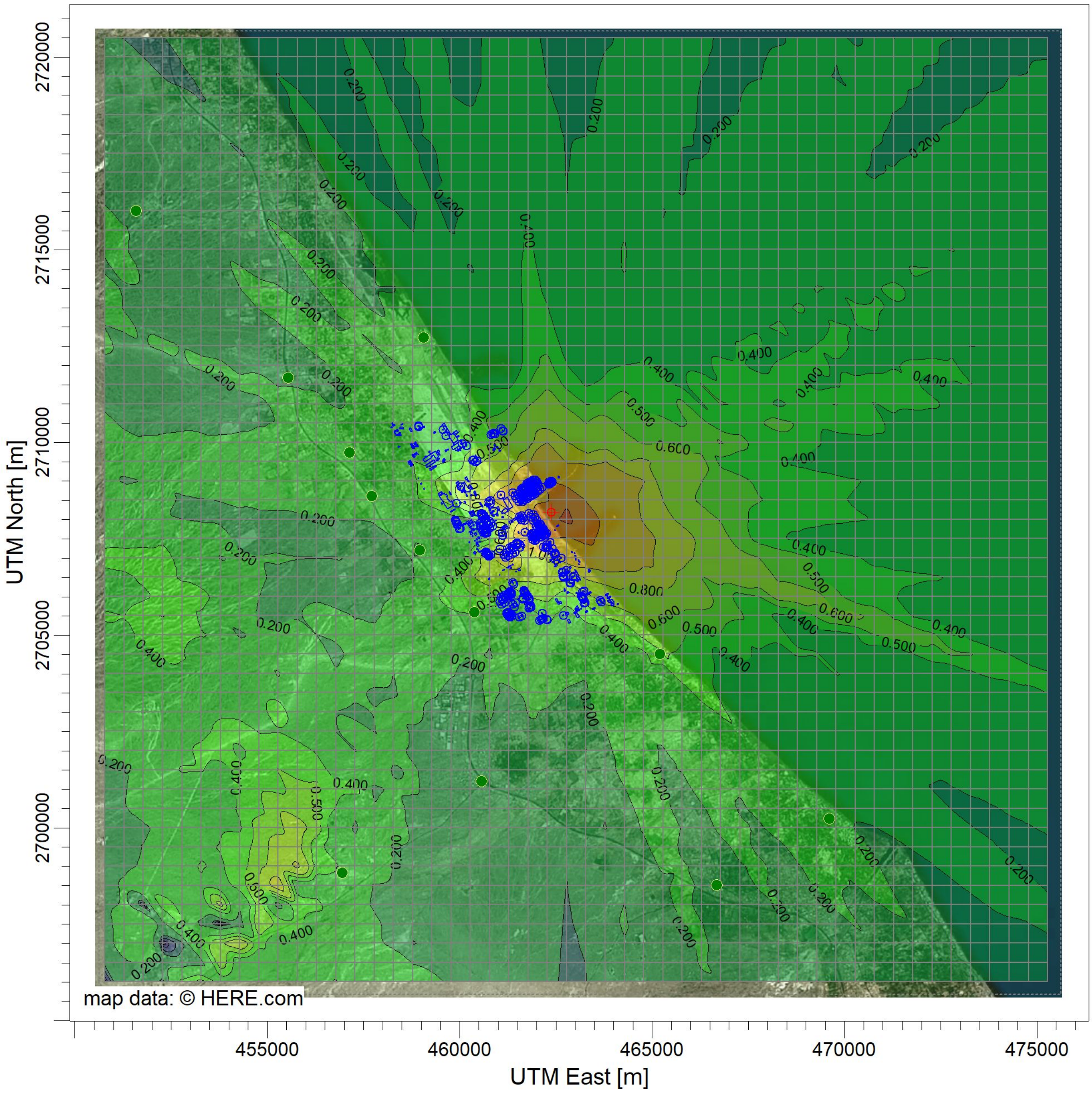
Max: 13.2 [ug/m^3] at (462281.06, 2708010.90)

0.4 0.5 0.6 0.8 1.0 3.0 5.0 6.0 8.0 10.0 13.2

COMMENTS:	SOURCES:	COMPANY NAME:	
	1		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:171,058 0 5 km	
	MAX: **13.2 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

TOTAL LNG SO2 - 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

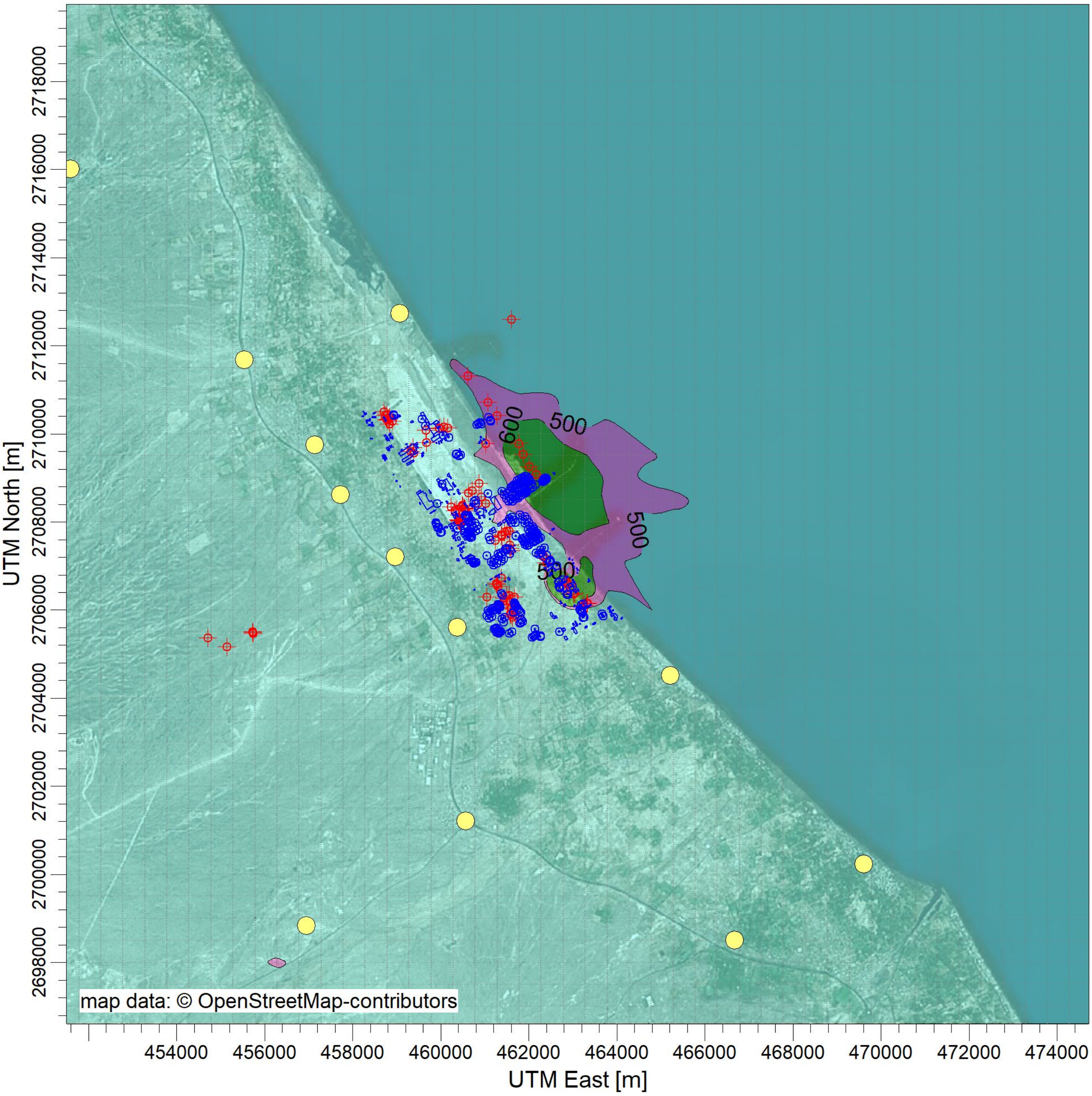
Max: 4.587 [ug/m^3] at (462781.06, 2708010.90)

0.046 0.050 0.060 0.080 0.100 0.200 0.400 0.500 0.600 0.800 1.000 2.000 4.000 4.587

COMMENTS:	SOURCES: **1**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:171,058 0 5 km	
	MAX: **4.587 ug/m^3**	DATE: **7/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

CO Currant operational (SPF) µg/m3 8hr



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 1255 [ug/m^3] at (462781.06, 2706510.90)

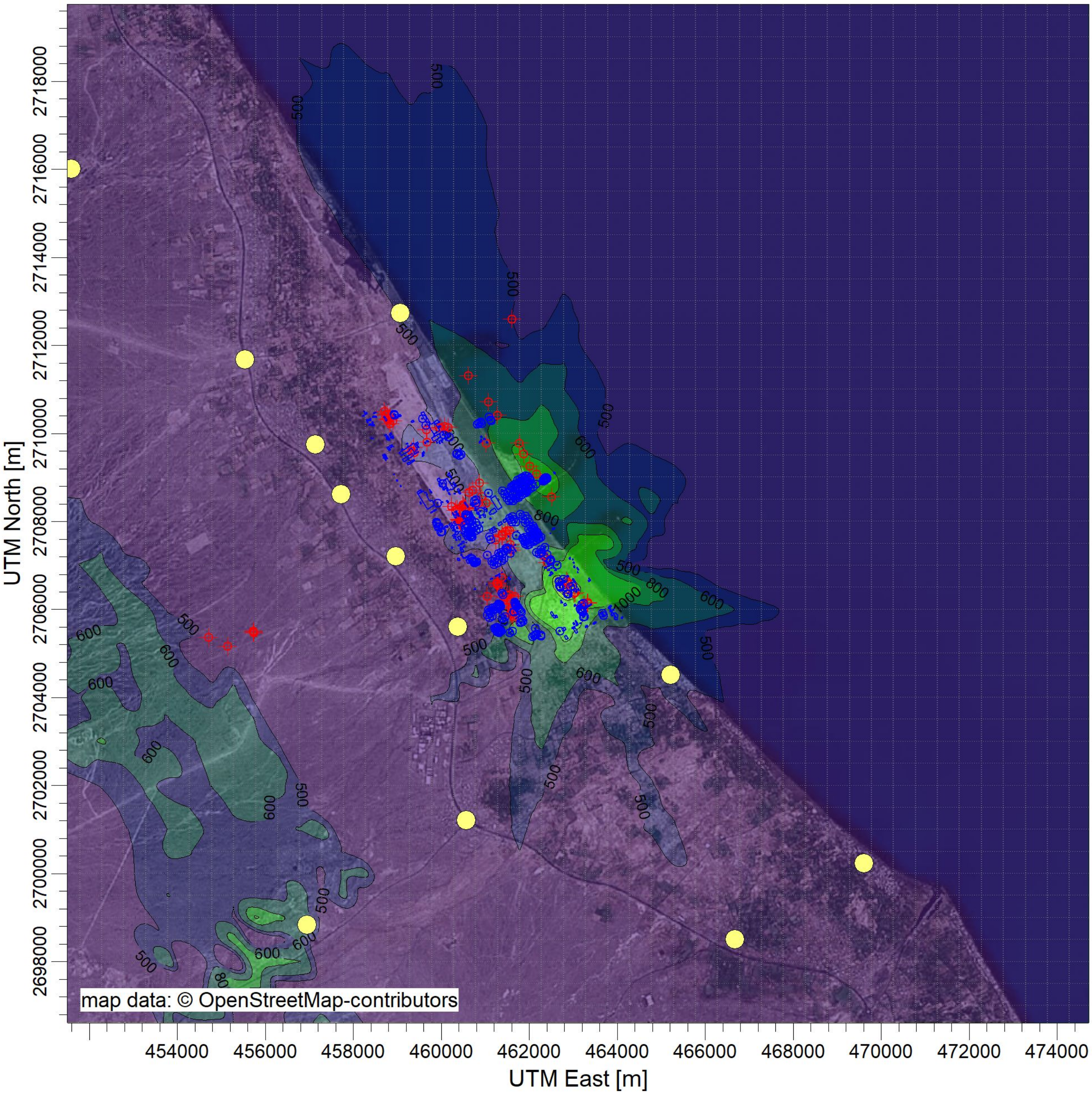
294 500 600 950 1000 1255

COMMENTS:	SOURCES:	COMPANY NAME:	
CO result without TOTAL	**94**		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:150,000 (0 — 5 km)	
	MAX: **1255 ug/m^3**	DATE: **6/10/2020**	PROJECT NO.: **02520**

AERMOD View - Lakes Environmental Software

PROJECT TITLE:

CO Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 1hr



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 6398 [ug/m^3] at (462781.06, 2706510.90)

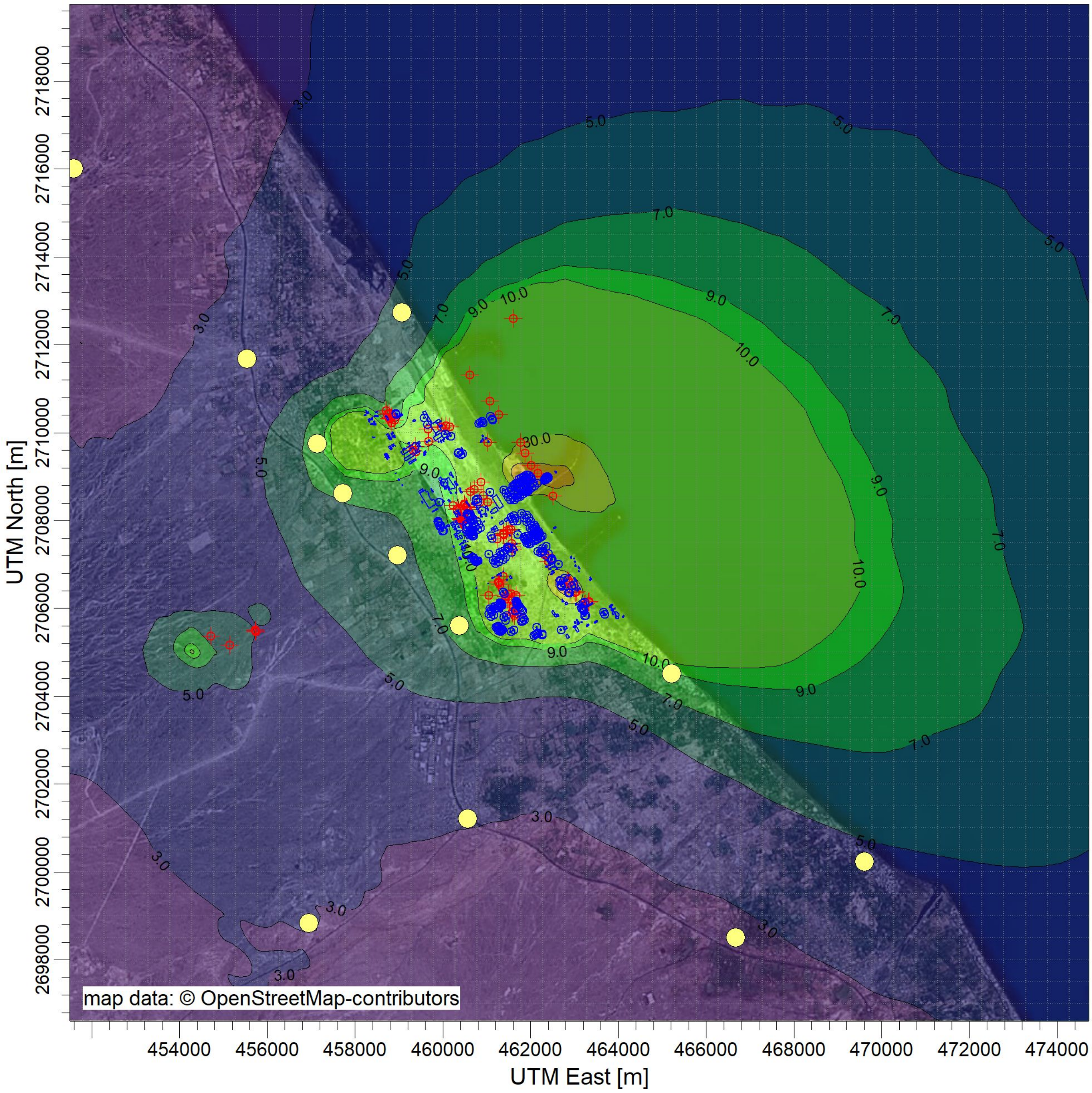
160 500 600 800 1000 3500 4500 5000 6000 6398

COMMENTS:	SOURCES:	COMPANY NAME:	
TOTAL LNG 2023	**96**		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:150,000 (0 — 5 km)	
	MAX: **6398 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\2020 05 27 TOTAL CO (Start up)+ Port\2020 05 27 TOTAL CO (Start up)+ Port.isc

PROJECT TITLE:

CO Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 1yr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 8 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 75.8 [ug/m^3] at (462781.06, 2706510.90)

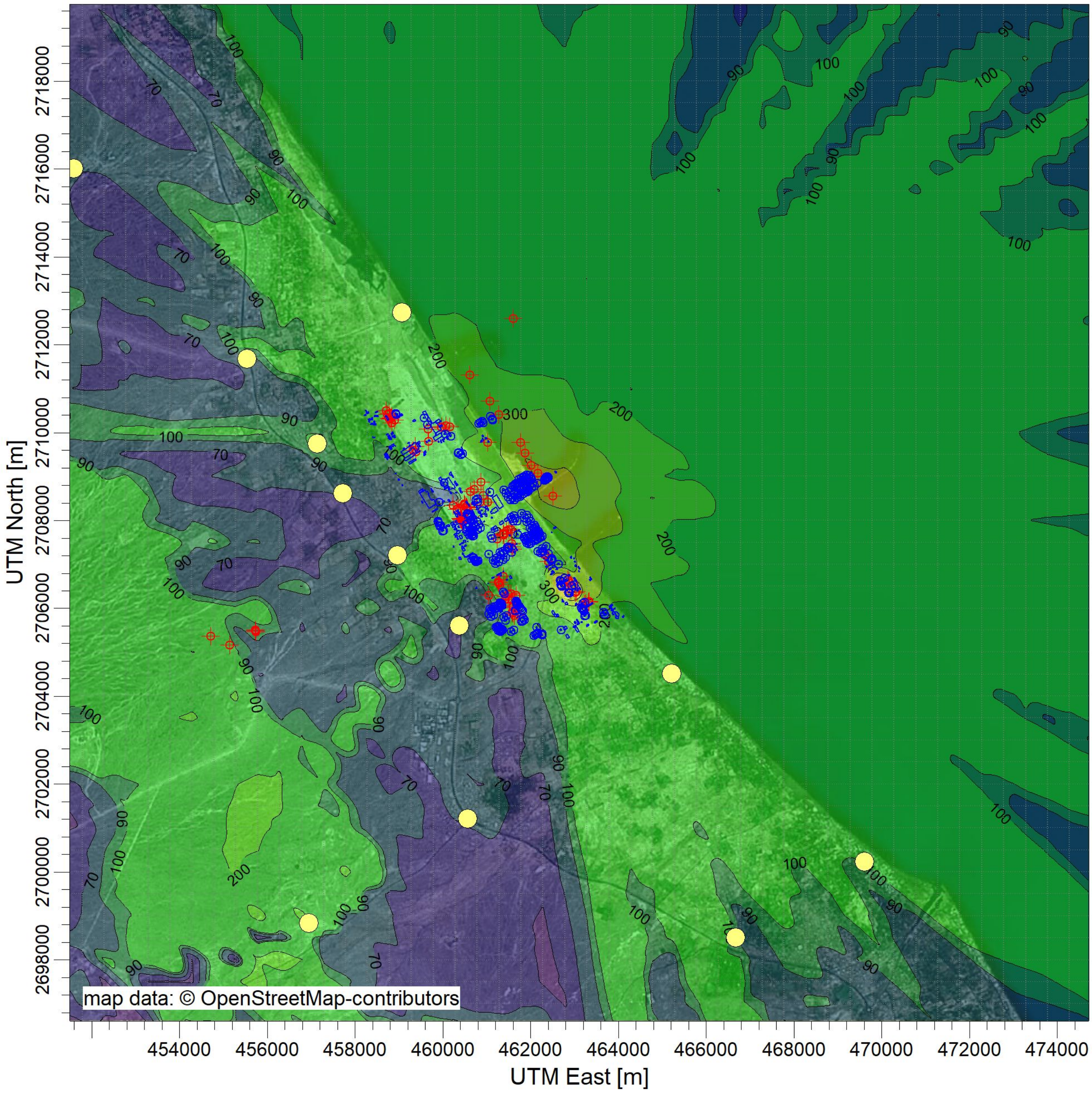
1.8 3.0 5.0 7.0 9.0 10.0 30.0 50.0 70.0 75.8

COMMENTS:	SOURCES:	COMPANY NAME:	
TOTAL LNG 2023	**96**		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:150,000 0 5 km	
	MAX: **75.8 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\2020 05 27 TOTAL CO (Start up)+ Port\2020 05 27 TOTAL CO (Start up)+ Port.isc

PROJECT TITLE:

CO Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 8hr



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 996 [ug/m^3] at (462781.06, 2706510.90)

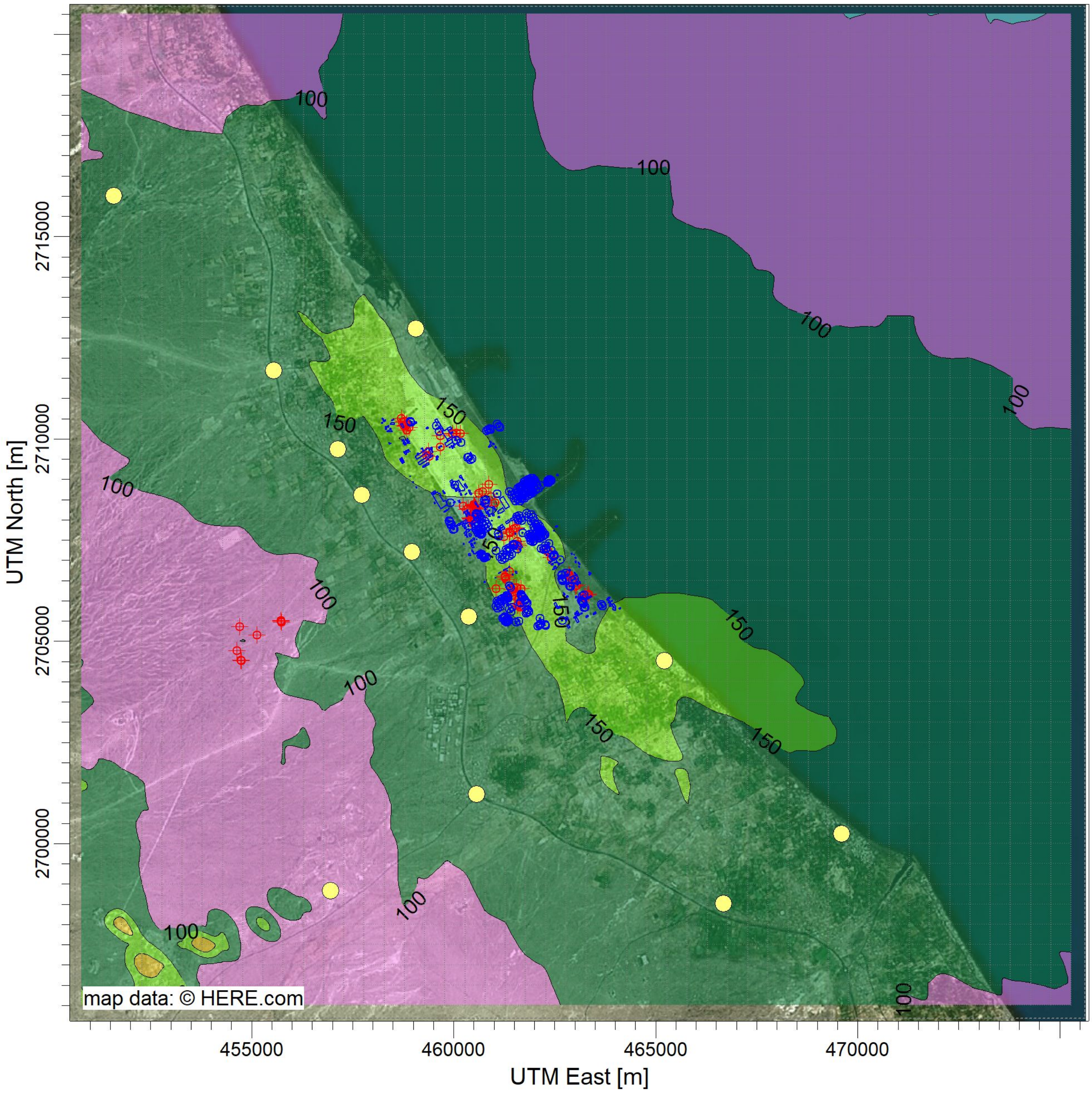
36 50 70 90 100 200 300 500 700 900 996

COMMENTS: TOTAL LNG 2023	SOURCES: **96**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:150,000 0 5 km	
	MAX: **996 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\2020 05 27 TOTAL CO (Start up)+ Port\2020 05 27 TOTAL CO (Start up)+ Port.isc

PROJECT TITLE:

NO2 for Currant operational (SPF) µg/m3 1Hr



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 267 [ug/m^3] at (453781.06, 2697510.90)

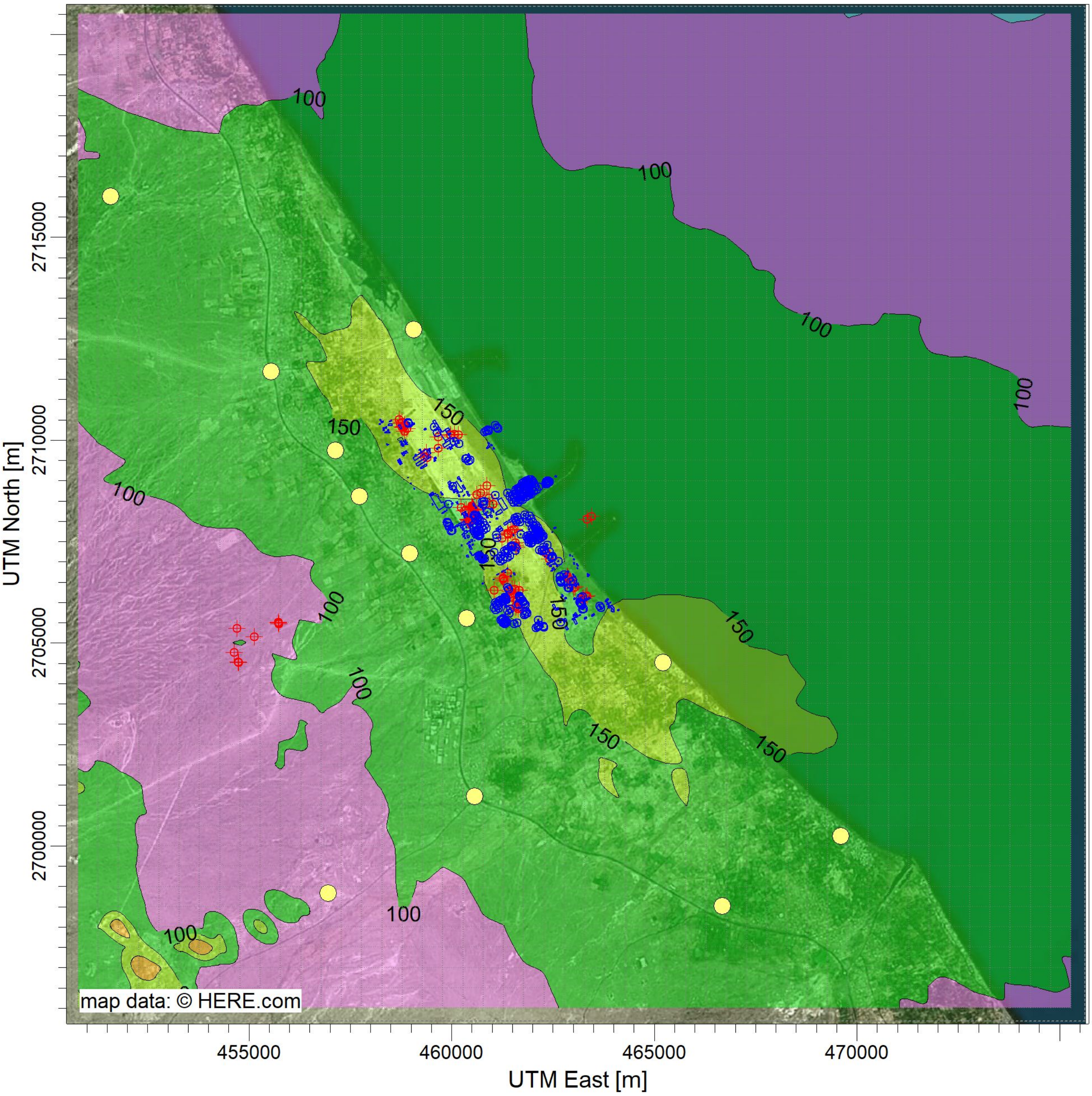
79	80	100	150	200	267

COMMENTS:	SOURCES: 88	COMPANY NAME:	
	RECEPTORS: 2512	MODELER:	
	OUTPUT TYPE: Concentration	SCALE: 1:162,914 (0 – 5 km)	
	MAX: 267 ug/m^3	DATE: 6/10/2020	PROJECT NO.:

AERMOD View - Lakes Environmental Software

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG normal operation µg/m3 1hr



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

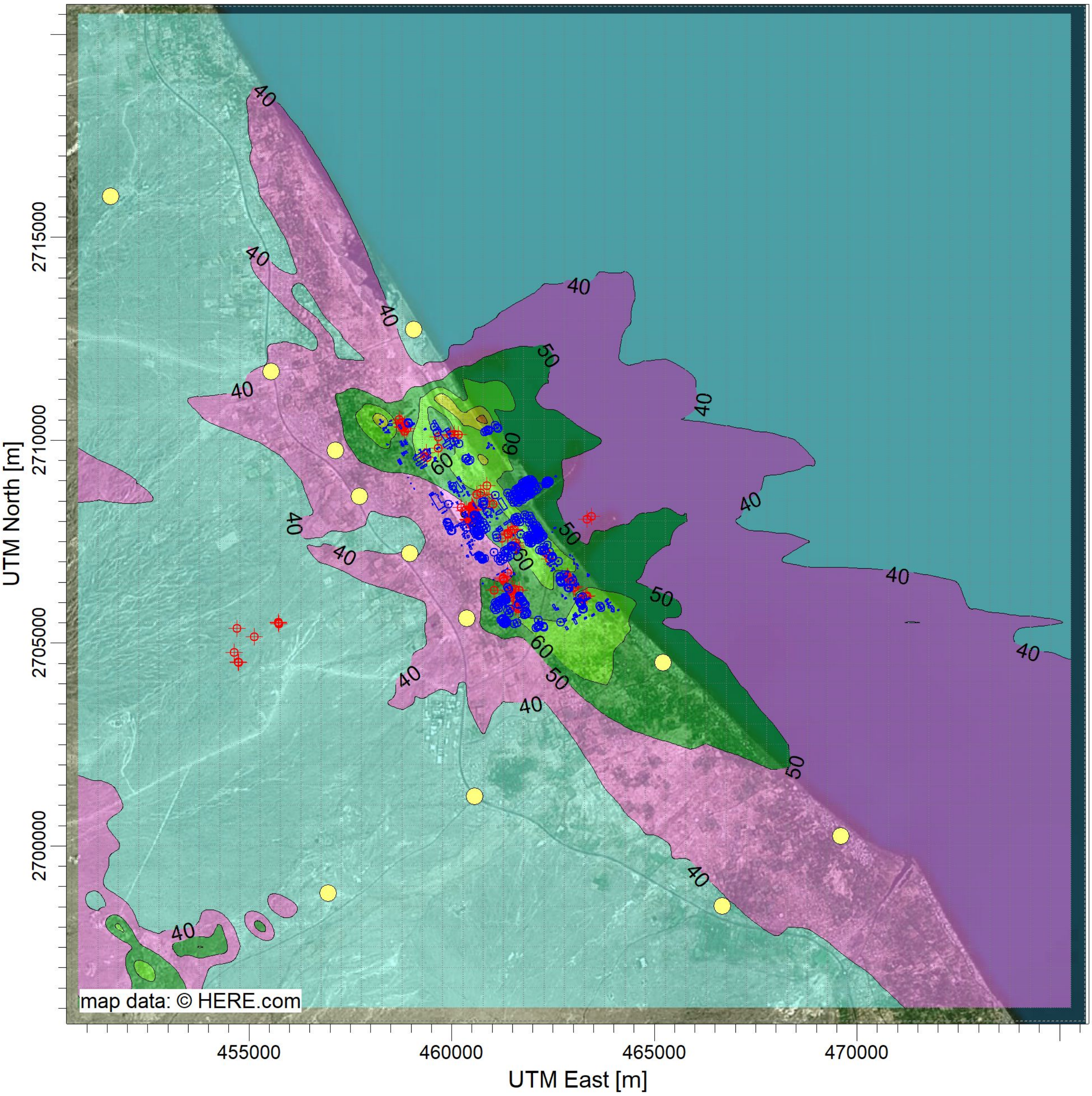
ug/m^3

Max: 267 [ug/m^3] at (453781.06, 2697510.90)

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **267 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG normal operation µg/m3 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

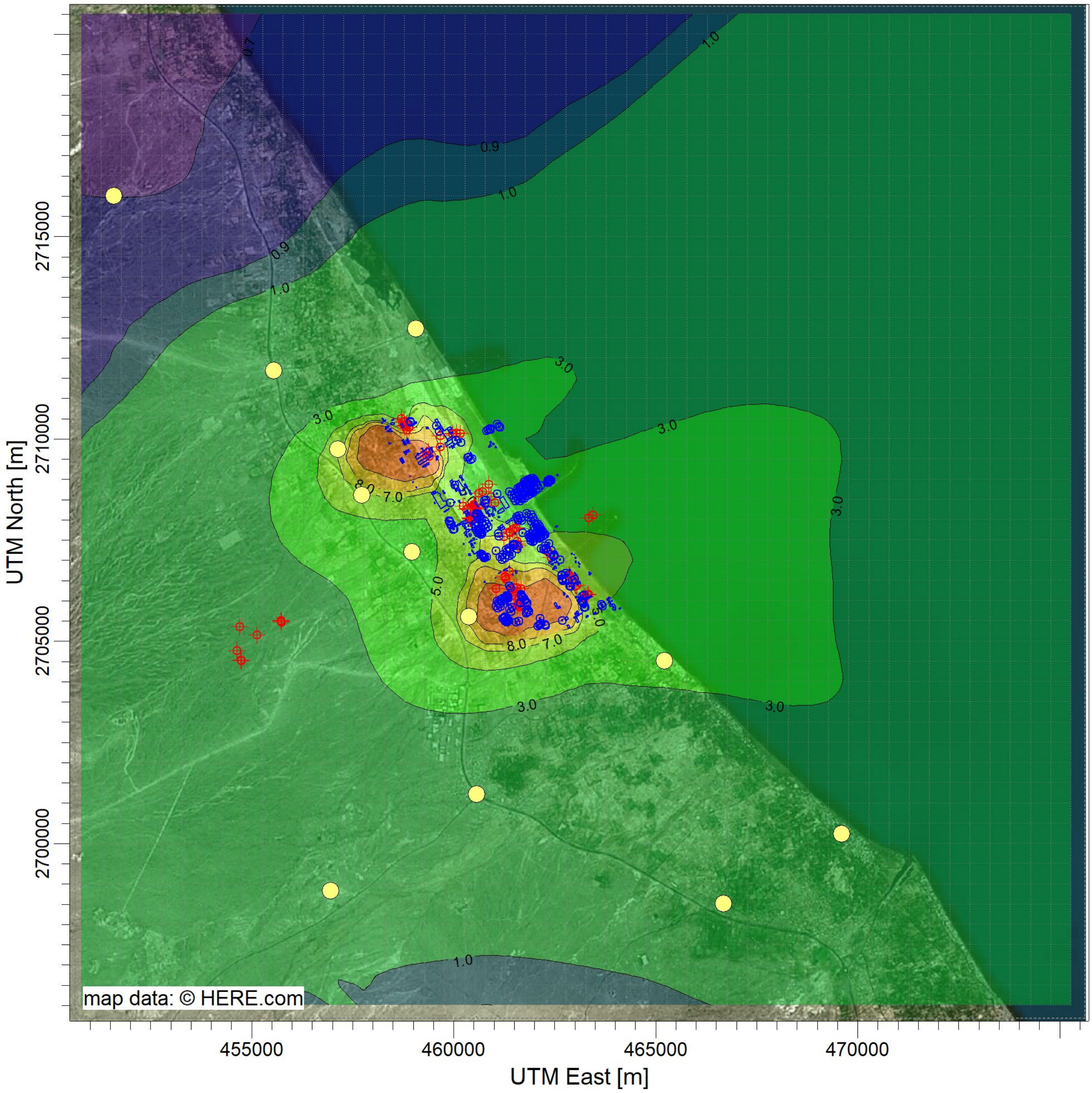
Max: 85.0 [ug/m^3] at (460781.06, 2710510.90)

31.7 40.0 50.0 60.0 70.0 80.0 85.0

COMMENTS:	SOURCES:	COMPANY NAME:	
	90		
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **85.0 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG normal operation µg/m3 1yr



POST/PLOT FILE OF ANNUAL VALUES FOR YEAR 1 FOR SOURCE GROUP: ALL

ug/m^3

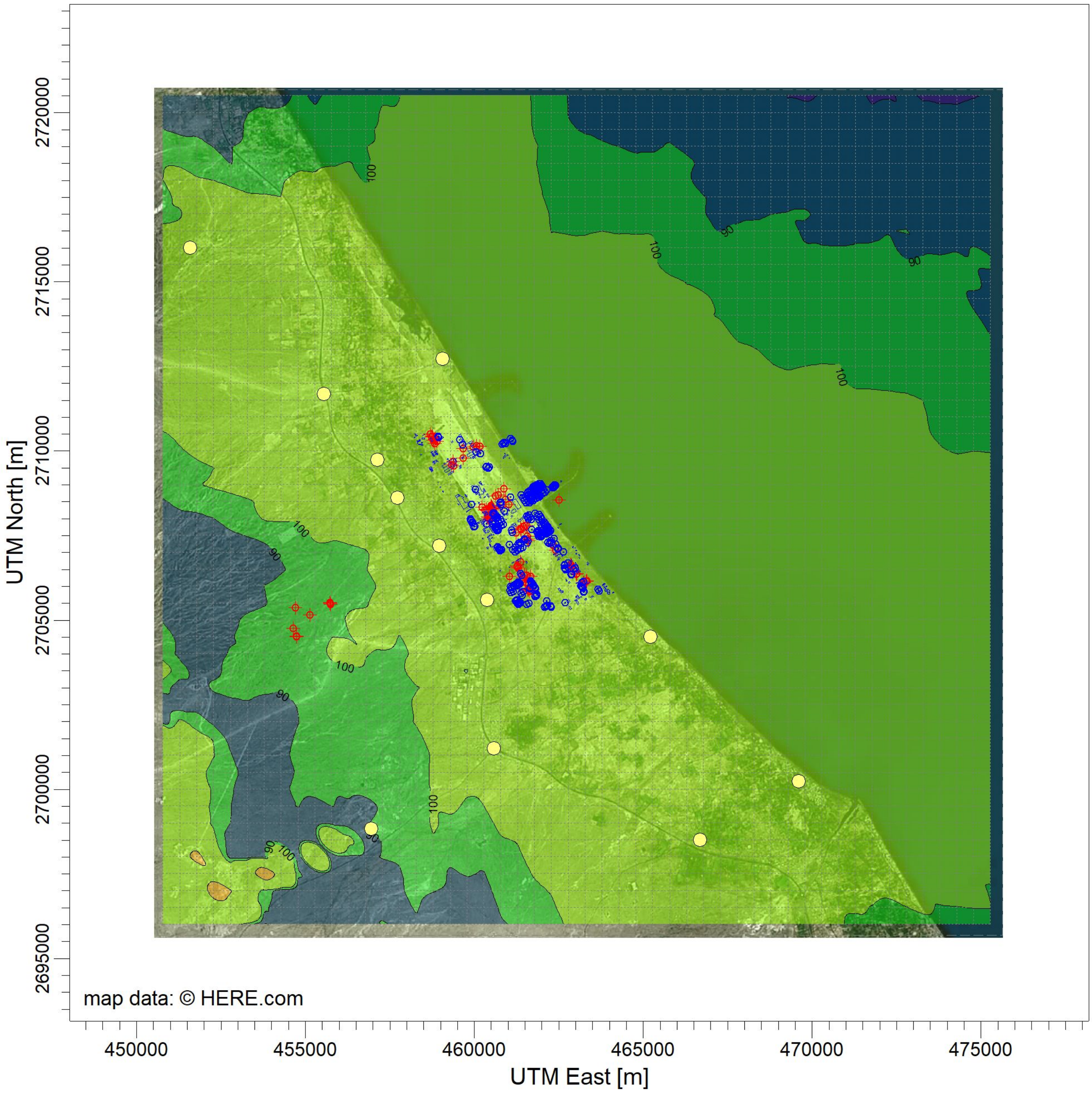
Max: 18.7 [ug/m^3] at (458281.06, 2710010.90)

0.5 0.7 0.9 1.0 3.0 5.0 7.0 8.0 10.0 18.7

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 — 5 km	
	MAX: **18.7 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 1hr



PLOT FILE OF HIGH 8TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

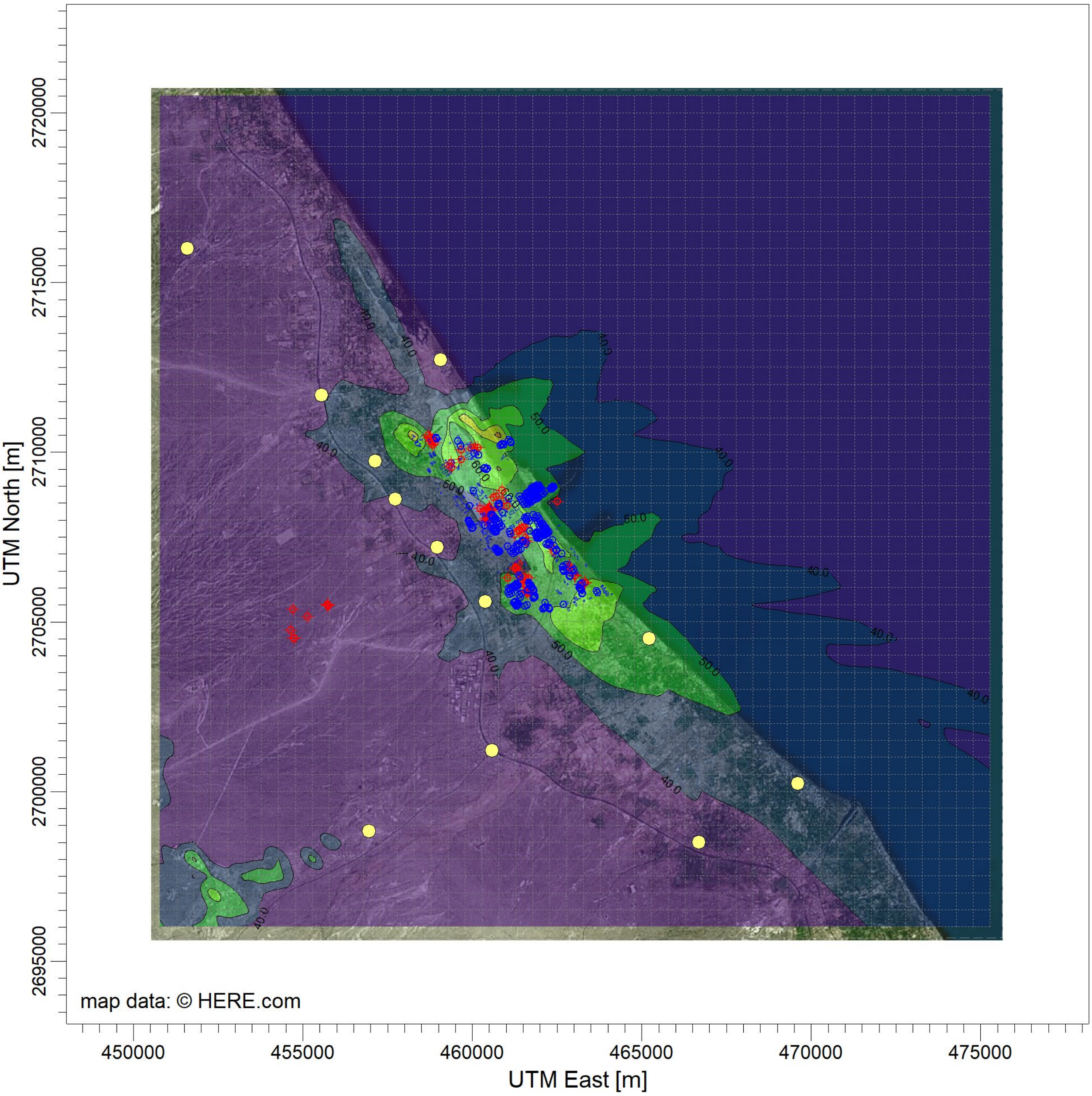
ug/m^3

Max: 266 [ug/m^3] at (453781.06, 2697510.90)

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:194,857 0 5 km	
	MAX: **266 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

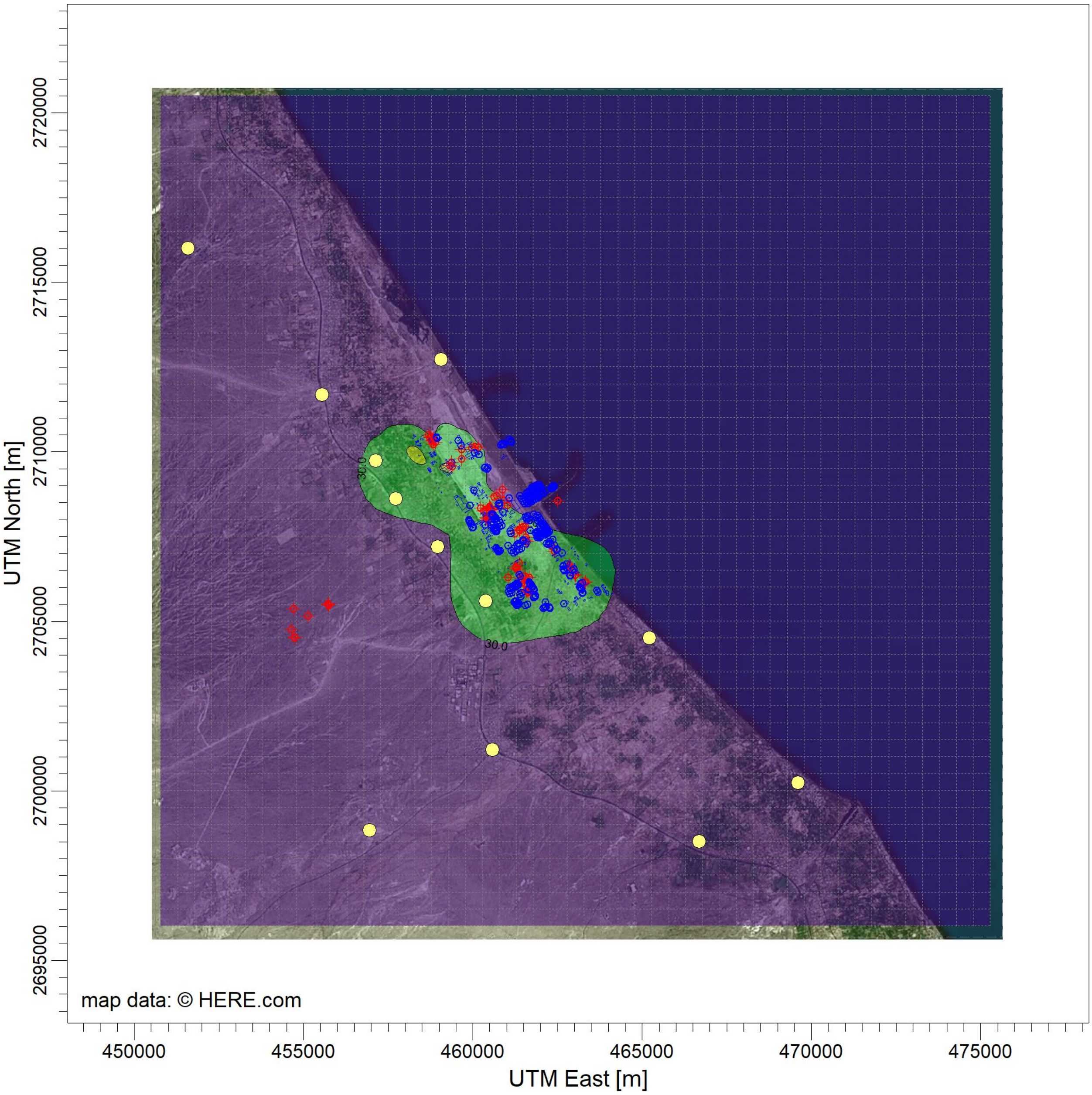
Max: 83.4 [ug/m^3] at (460781.06, 2710510.90)

30.3 | 40.0 | 50.0 | 60.0 | 70.0 | 80.0 | 83.4

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:194,857 0 — 5 km	
	MAX: **83.4 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

NO2 Currant operational (SPF) + TOTAL LNG Start up operation µg/m3 1yr



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 8 YEARS FOR SOURCE GROUP: ALL ug/m^3

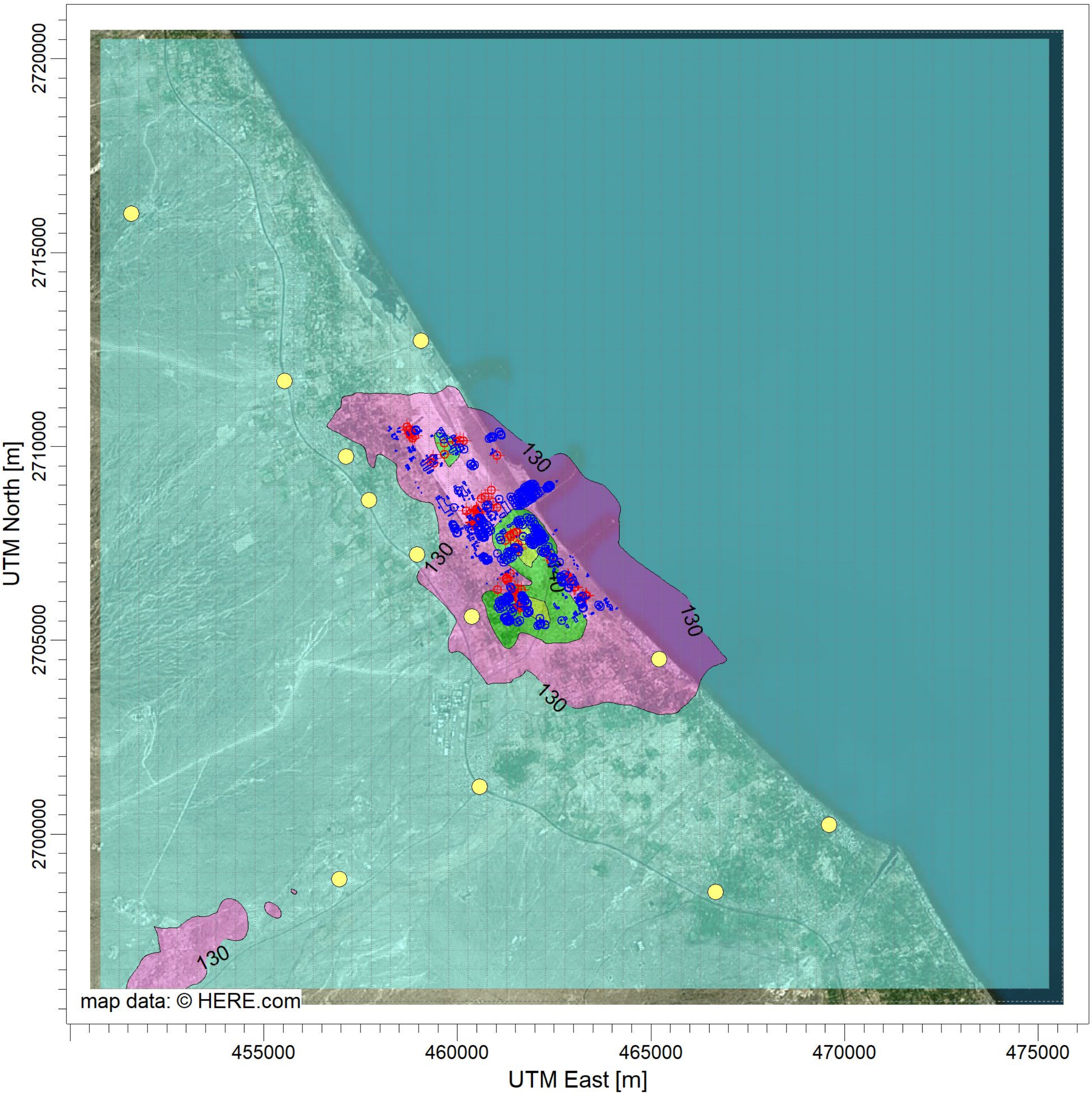
Max: 44.0 [ug/m^3] at (458281.06, 2710010.90)

25.5 | 30.0 | 40.0 | 44.0

COMMENTS:	SOURCES: 90	COMPANY NAME:	
	RECEPTORS: 2512	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:194,857 (0 — 5 km)	
	MAX: **44.0 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG 2023**

PROJECT TITLE:

PM Currant operational (SPF) µg/m3 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 160.7 [ug/m^3] at (461781.06, 2707510.90)

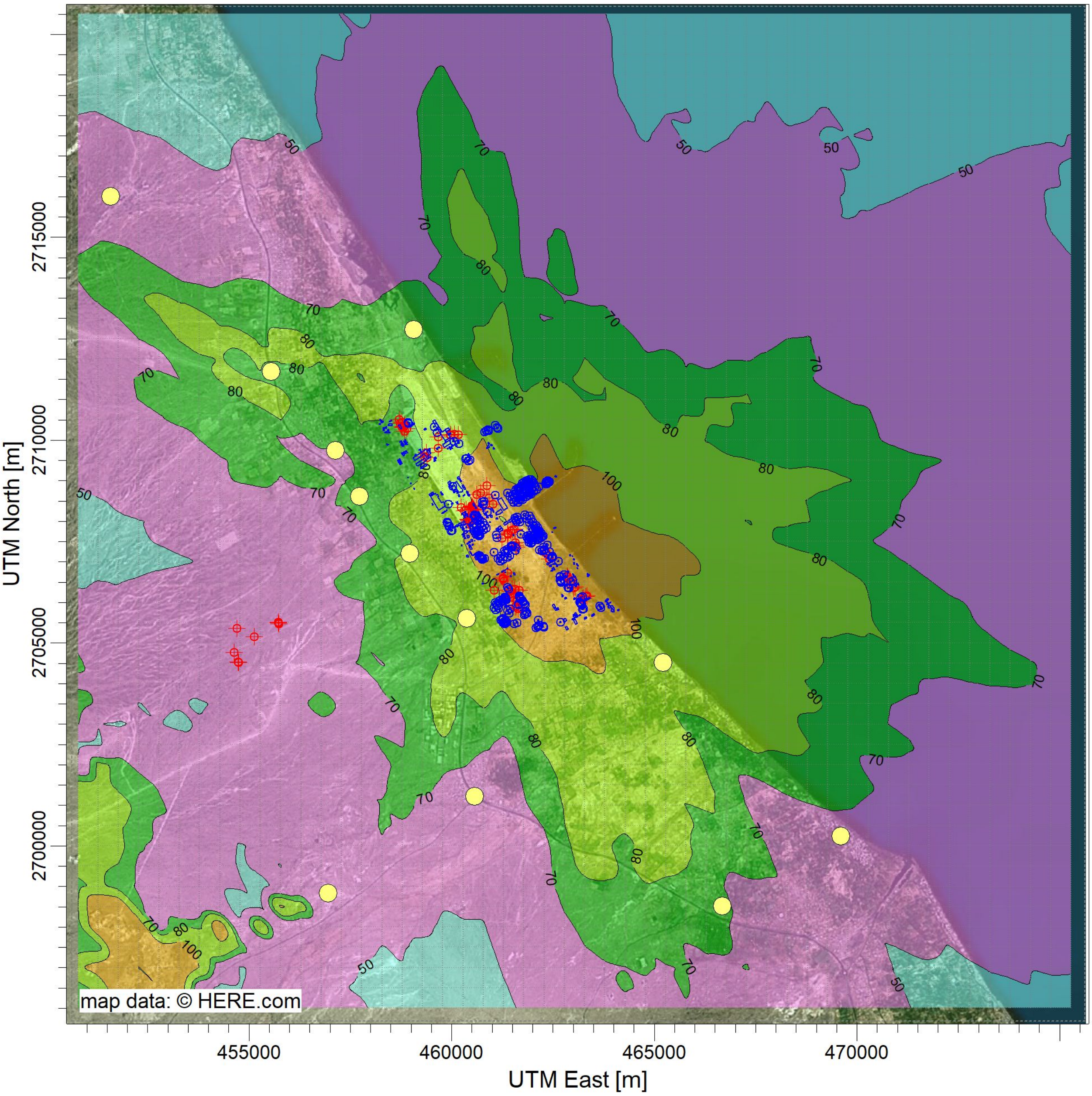
123.0 | 130.0 | 140.0 | 150.0 | 160.0 | 160.7

COMMENTS:	SOURCES: **81**	COMPANY NAME:
	RECEPTORS: **2512**	MODELER:
	OUTPUT TYPE: **Concentration**	SCALE: 1:170,497 0 5 km
	MAX: **160.7 ug/m^3**	DATE: **6/10/2020**	PROJECT NO.:

AERMOD View - Lakes Environmental Software

PROJECT TITLE:

SO2 Currant operational (SPF) µg/m3 1hr



PLOT FILE OF HIGH 4TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 162 [ug/m^3] at (461281.06, 2707510.90)

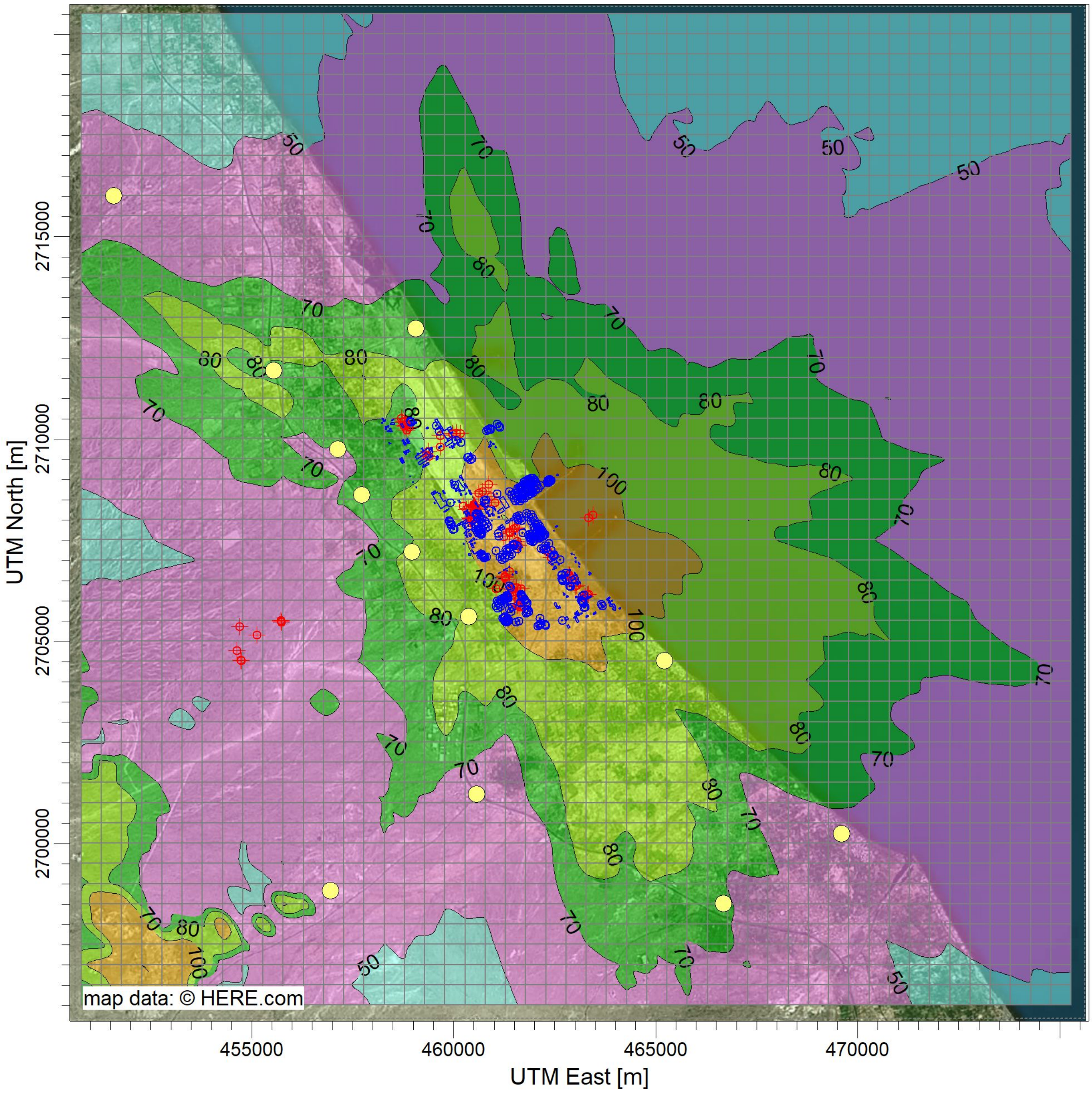
37	50	70	80	100	162

COMMENTS:	SOURCES: **88**	COMPANY NAME:
	RECEPTORS: **2512**	MODELER:
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km
	MAX: **162 ug/m^3**	DATE: **6/10/2020**
		PROJECT NO.:

AERMOD View - Lakes Environmental Software

PROJECT TITLE:

SO2 Currant operational (SPF) + TOTAL LNG normal operation µg/m3 1hr



PLOT FILE OF HIGH 4TH HIGH 1-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

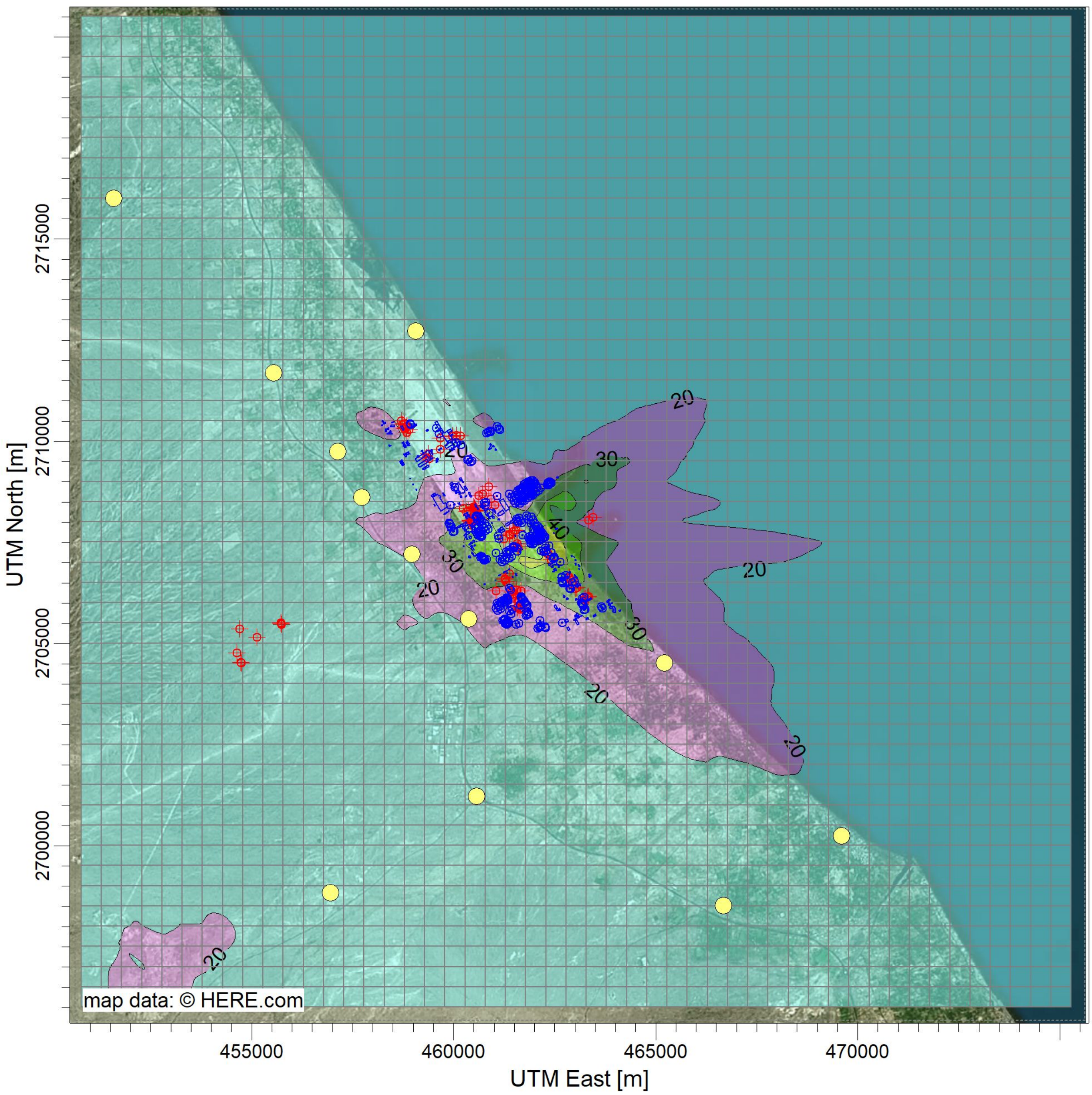
Max: 162 [ug/m^3] at (461281.06, 2707510.90)

37 50 70 80 100 162

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **162 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG**

PROJECT TITLE:

SO2 Currant operational (SPF) + TOTAL LNG normal operation µg/m3 24hr



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

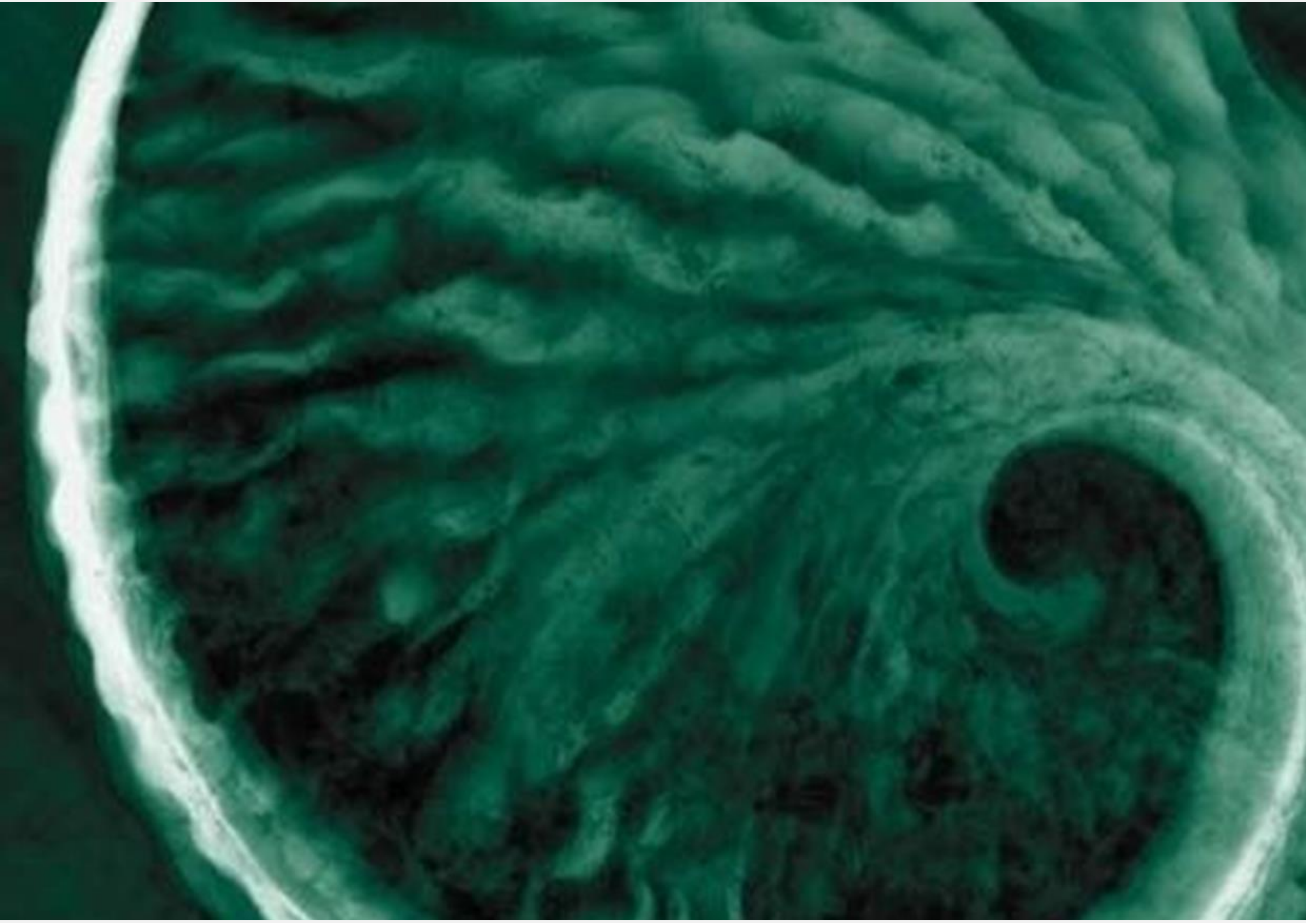
ug/m^3

Max: 61.4 [ug/m^3] at (462281.06, 2707510.90)

10.6	20.0	30.0	40.0	50.0	60.0	61.4

COMMENTS:	SOURCES: **90**	COMPANY NAME:	
	RECEPTORS: **2512**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:162,914 0 5 km	
	MAX: **61.4 ug/m^3**	DATE: **9/8/2023**	PROJECT NO.: **TOTAL LNG**

APPENDIX D CLIMATE CHANGE RISK ASSESSMENT (CCRA)



Appendix D - Climate Change Risk Assessment (CCRA)

MARSA LNG Bunkering Project, Sohar, Oman

28 November 2023

Project No.: 0523286

The business of sustainability

ERM

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Author	ERM
Client Name	MARSA LNG LLC (TotalEnergies)

Document history

				ERM approval to issue		
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Draft	2.0	ERM	Charles Gooderham Iulia Luta	Matteo Veronesi	20.10.2023	For TE's review
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INTRODUCTION

Appendix D presents a Climate Change Risk Assessment (CCRA) which comprises a comprehensive climate affairs study essential for the overarching Environmental and Social Impact Assessment (ESIA) of MARSA LNG LLC's LNG Bunking Project in Sohar.

In the pursuit of a sustainable and responsible approach to Project development, this Appendix is aligned with the Omani Regulations for the Management of Climate Affairs ('Guidelines for the Preparation of Climate Affairs Chapter in the Environmental Impact Assessment (EIA) Study for the projects') and follows the Equator Principles 4 (EP4) Guidance Note for CCRA's (initially EP4 published its CCRA guidance in September 2020, which has since been superseded with updated guidance being published in May 2023).

To facilitate a structured analysis, this appendix is organized into two distinct parts: (Part 1) Physical Risks and Opportunities Screening and (Part 2) GHG Emissions Inventory. According to EP4, for projects classified as Category A (as in this case), a Physical CCRA and a GHG Emissions Assessment are required by default, and when combined Scope 1 and Scope 2 GHG emissions are expected to exceed 100,000 tCO_2 equivalent annually, the requirement of a Transition CCRA and GHG Alternatives Analysis (AA) is triggered. As described in this CCRA, with electricity being supplied by a Solar Plant to the LNG Plant during operation, the total GHG emissions of the Project fall below this threshold; therefore, these two latter assessments are not required. It should be noted that additional CCRA phases will be undertaken for further considerations for the prospective Lenders, particularly for Part 1.

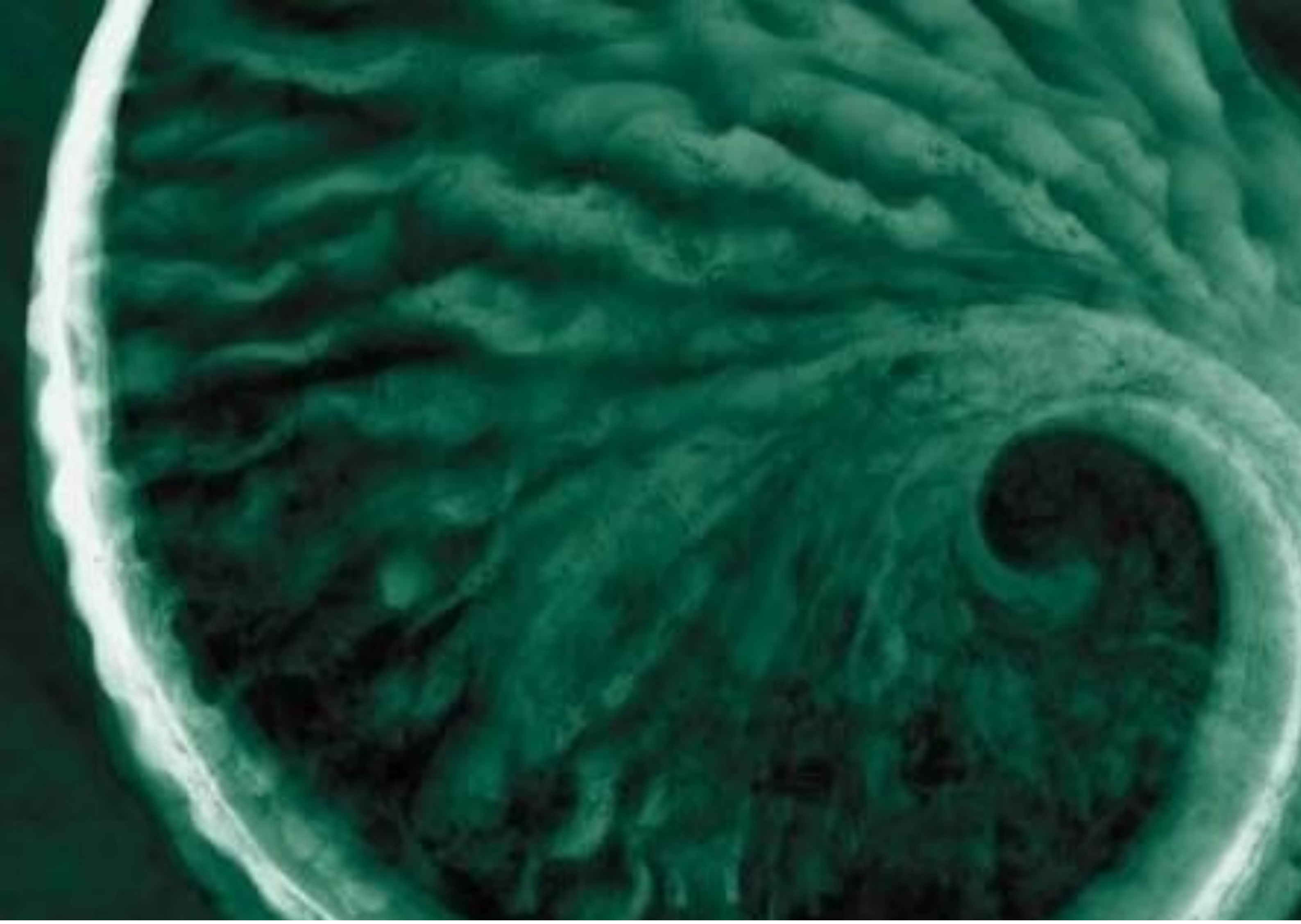
Through the diligent execution of these parts, the CCRA seeks to equip stakeholders with a thorough understanding of the climate-related considerations associated with the Project. By integrating these assessments into the broader ESIA, the Project is committed to promoting a responsible development that aligns with global sustainability objectives and fosters resilience in the face of a changing climate.

The CCRA has followed EP4 standards, and deepens the requirements established in the national Omani MECA (now EA) Climate Affairs Guidelines (2013).The following table provides a summary of how this CCRA meets the Omani requirements on the Climate Affairs Chapter.

Omani Climate Affairs Chapter Topics	Appendix D - CCRA
Ozone Depleting Substances (ODS)	Section 4.4 of Part 2 – GHG Emissions Inventory
Energy Consumption	Section 4.1.1 of Part 2 – GHG Emissions Inventory Section 4.2.1 of Part 2 – GHG Emissions Inventory
Detailed GHG Emissions Inventory (Construction and Operation)	Chapter 4 of Part 2 – GHG Emissions Inventory
GHG Mitigation Measures	GHG mitigation measures considered by the Project are reviewed in Annex 3 of Part 2 – GHG Emissions Inventory.
Green Belt Development Plan	Not Applicable. The Project does not have any direct plans for "green belts" or "green cover" for the purposes of mitigating GHG. Other GHG mitigation measures considered by the Project are reviewed in Annex 3 of Part 2 – GHG Emissions Inventory.
Detailed Climate Change Risks Assessment	Part 1 – Physical Risks and Opportunities Screening
Climate Affairs Risk Reduction Plan (CARRP)	Recommended actions per climate change risk are included in Section 3.2 of Part 1 – Physical Risks and Opportunities Screening. Section 2.1.1 of Part 1 – Physical Risks and Opportunities Screening.
Monitoring, Follow Up and Adaptative Management	Section 2.1.2 of Part 1 – Physical Risks and Opportunities Screening.

PART 1

PHYSICAL RISKS AND OPPORTUNITY SCREENING



CCRA Part 1: Physical Risks and Opportunity Screening

MARSA LNG Bunkering Project, Sohar, Oman

25 October 2023

Project No.: 0523286

The business of sustainability

ERM

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CONTENTS

EXECUTIVE SUMMARY 4

1. INTRODUCTION 7

- **1.1 Scope** 7

2. METHODOLOGY 10

- **2.1 Overall EP4-aligned CCRA methodology** 10
- **2.2 Assessment Phase 1 approach: risk and opportunity screening** 10
  - 2.2.1 Climate Change Risk Reduction and Adaptation Plan 13
  - 2.2.2 Monitoring, Follow Up and Adaptive Management 13
- **2.3 CCRA limitations and assumptions** 14

3. TRENDS ANALYSIS AND RISK REVIEW 15

- **3.1 Project area climate** 15
- **3.2 Hazards carried through to risk review** 15
  - 3.2.1 Extreme heat 15
  - 3.2.2 Flooding 20
  - 3.2.3 Extreme winds 24
  - 3.2.4 Wildfires 28
  - 3.2.5 Water stress and drought 32
- **3.3 Hazards excluded from risk review** 36

4. SUMMARY AND CONCLUSION 37

5. ANNEXES 38

ANNEX 1 PROPOSED PROJECT SITE MAP

ANNEX 2 DETAILED OVERVIEW OF CLIMATE DATA, SCENARIOS AND TIME HORIZONS

ANNEX 3 DEFINITIONS OF ALL CLIMATE HAZARDS INCLUDED WITHIN THIS ASSESSMENT

ANNEX 4 CONSTRUCTION, PRECOMISSIONING AND COMISSIONING PHASE ACTIVITIES ASSOCIATED WITH THE PROJECT

List of Tables

Table 2-1 Definitions of the potential risk areas to the Project 12
Table 2-2 Definitions of the impact categories for potential risks to the Project 12
Table 2-3 Inherent risk materiality ratings and associated definitions 13
Table 3-1 Baseline and projected extreme heat climate data 16
Table 3-2 Extreme heat inherent risk materiality ratings 17
Table 3-3 Baseline and projected flooding climate data 21
Table 3-4 Flooding inherent risk materiality ratings 21
Table 3-5 Baseline and projected extreme winds climate data 25
Table 3-6 Extreme winds inherent risk materiality ratings 26
Table 3-7 Baseline and projected wildfires climate data 29
Table 3-8 Wildfire inherent risk materiality ratings 29
Table 3-9 Baseline and projected water stress and drought climate data 33
Table 3-10 Water stress and drought inherent risk materiality ratings 33
Table 3-11 Table showing the rationale for hazard exclusion from risk review 36

List of Figures

Figure 1-1: Timeline of the Project 9
Figure 2-1 A three phased approach to undertaking physical CCRA's in alignment with EP4 guidance (2023) 10
Figure 5-1 Map of the Project location 39

Acronyms and Abbreviations

Name	Description
AR	Assessment Reports
CapEx	Capital Expenditure
CCRA	Climate Change Risk Assessment
CIP	ERM's Climate Impact Platform
CMIP6	World Climate Research Programme's Coupled Model Intercomparison Project 6 (used by the IPCC)
CSDI	Cold Spell Duration Index
EP4	Equator Principle 4
ESA	European Space Agency
ESIA	Environmental and Social Impact Assessment
FFDI	Forest Fire Danger Index
GCD	ERM's Global Climate Database
GCM	Global Climate Model
GHG	Greenhouse Gas
HSE	Health, Safety and Environmental
IBTrACS	International Best Track Archive for Climate Stewardship
IFC	International Finance Corporation
IFC PS	International Finance Corporation Environmental and Social Performance Standards
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
IR	Information Request
IRECs	International renewable energy certificate (issued under The International REC Standard)
LNG	Liquified Natural Gas
MISC	Majis Industrial Services Company
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OETC	Oman Electrical Transmission Company
OpEx	Operational Expenditure
Physical CCRA	Physical Climate Change Risk Assessment
RCM	Regional Climate Model
RCP	IPPC Representative Concentration Pathway
SSP	IPPC Shared Socio-economic Pathway
SWI	Seawater Intake
TCFD	Task Force on Climate-Related Financial Disclosures
WSDI	Warm Spell Duration Index
WRI	World Resource Institute

EXECUTIVE SUMMARY

Environmental Resources Management Ltd (ERM) has been commissioned by MARSA LNG LLC (TotalEnergies) (also referred to as the "Client") to undertake a Climate Change Risk Assessment (CCRA), as a part of a larger Environmental and Social Impact Assessment (ESIA) – in support of the proposed development of a Liquefied Natural Gas (LNG) Bunkering Project within the Sohar Industrial Port in Oman (hereafter referred to as "The Project").

This CCRA is made up of three distinct phases of analysis, the first of which is included within this report. This first phase of analysis includes an assessment of the current and future projected inherent physical climate-related risks ('inherent' refers to risks posed to the Project in the absence of further management/mitigation measures) which could be material in relation to the construction and operational phases of the Project. This assessment utilises projected climate data across three timeframes: baseline (present day), 2030 and 2050 and two climate scenarios (representing a 1.8° and 4.4°C temperature increase by 2100 compared to pre-industrial average temperatures).

Based upon the climate data analysed within this report, a number of key hazards have been identified as posing the most material (inherent) risks in relation to the Project, including:

- Extreme heat;
- Coastal flooding;
- Extreme winds and storms; and
- To a lesser extent wildfires and water stress and drought. Whilst trends indicate an increase in the intensity/frequency of wildfires and water stress and drought in the region, the associated risks are anticipated to be of lower materiality to the Project compared to extreme heat, coastal flooding, and extreme winds and storms.

Following the identification of relevant hazards, a longlist of key associated risks has been generated – which are anticipated to have the potential to be material to construction and/or operational phase of the Project. Below is a summary of the most material risks (e.g. those rates as 'Likely Material – Moderate to High') which were identified as a part of this assessment, including the identification of:

- The aspect of the Project each risk is associated with (referred to as 'risk areas'); and
- A summary of ERM's recommended next steps for each risk.

Risk area/areas	Risk ID	Summary of inherent risk	Recommended next steps
Site Personnel	EXH1	▪ With increased temperatures, personnel could experience dehydration, heat stress, heat exhaustion and, in severe cases, heat stroke. ▪ With an already high baseline risk level, and projected increases in extreme heat, site personnel productivity and site revenue could reduce.	▪ Consider embedding extreme heat within health and safety management plans. ▪ Assess this risk further in follow-on phases of assessment.

Risk area/areas	Risk ID	Summary of inherent risk	Recommended next steps
LNG Plant	EXH2 & EXH3	▪ Extreme heat can cause an increase in ambient temperatures, and has the potential to increase cooling requirements and/or reduce the efficiency of operations associated with the natural gas liquefaction process.	▪ Ensure that asset design specifications consider present and future projected extreme heat conditions. ▪ Assess this risk further in follow-on phases of assessment.
Pipelines	EH4 & EXH5	▪ Pipelines (both under and above ground) could be impacted by extreme heat e.g., through structural stress, pipeline movements, and damages that have the potential to cause negative environmental consequences such as water contamination.	▪ Ensure design specifications account for the potential impact of extreme heat on pipelines. ▪ Assess this risk further in follow-on phases of assessment.
LNG Plant	FL1	▪ Coastal flooding could lead to significant delays in the proposed construction completion date of the Project, potentially reducing revenues. ▪ Coastal and extreme rainfall flooding could disrupt LNG production and create unsafe working conditions for site personnel, potentially reducing revenues.	▪ Assess the need for the installation of flood barriers at the site to protect infrastructure and personnel from flood-related risks. ▪ Assess this risk further in follow-on phases of assessment.
Jetty	FL2	▪ Sea level rise/storm surges associated with coastal flooding could disrupt jetty construction, delaying Project completion, potentially increasing CapEx and reducing revenues. ▪ Coastal flooding can cause damage to the jetty's structural components, or associated equipment/machinery potentially increasing CapEx. ▪ Unsafe loading conditions may reduce revenues and cause downstream supply chain disruptions such as delivery delays for purchased goods.	▪ Undertake further assessment into whether the design specifications of the jetty and associated infrastructure are sufficient to withstand future projections of sea level rise. ▪ Assess this risk further in follow-on phases of assessment.

Risk area/areas	Risk ID	Summary of inherent risk	Recommended next steps
Site Personnel	FL3	▪ Flooding has the potential to cause health and safety risks to site personnel – e.g., contaminated water could transmit infectious diseases or floodwaters could cause slip hazards. ▪ Projected increases in flood depths could increase health and safety risks, reducing productivity, and therefore Project revenues.	▪ Consider embedding flooding within health and safety management plans. ▪ Assess this risk further in follow-on phases of assessment.
Electricity supply (including Solar Plant)	FL4	▪ During the construction phase, flooding could require increases in CapEx if damage to the diesel generators occurs. ▪ Damage to the Solar Plant could cause significant reputational impacts if the Project's Scope 2 emissions are not covered by matching IRECs because the plant is not operational.	▪ Undertake a further assessment into the proposed drainage system for the Solar Plant, and the overall resilience of the Solar Plant design to projected flood events. ▪ Assess this risk further in follow-on phases of assessment.
LNG Plant & Jetty	EW1 & EW2	▪ Extreme winds could lead to delays in Project completion, potentially impacting revenues, and CapEx. ▪ Extreme winds can disrupt the transport of LNG during the operational phase, reducing revenues.	▪ Undertake a further assessment of the potential impacts associated with extreme winds that may emerge in the future and influence the Project design, for example through undertaking a hazard/storm risk assessment. ▪ Assess this risk further in follow-on phases of assessment.
Electricity supply (including the Solar Plant)	EW3	▪ Damages to substations or power lines could result in delays in LNG production, reducing Project revenues. ▪ Damage to the Solar Plant from extreme winds and storms could cause significant reputational impacts if the Project's Scope 2 emissions are not covered by matching IRECs because the plant is not operational.	▪ Undertake a further assessment of the potential impacts associated with extreme winds that may emerge in the future and influence the Project design, for example through undertaking a hazard/storm risk assessment. ▪ Assess this risk further in follow-on phases of assessment.

It is recommended that all risks (including the additional lower materiality risks which are also included in Section 3.2) identified within this report are reviewed in further detail within follow-on phases of assessment with particular consideration being given to the most material risks – as listed in the table above)

1. INTRODUCTION

Environmental Resources Management Ltd (ERM) has been commissioned by MARSA LNG LLC (TotalEnergies – also referred to as the "Client") to undertake a physical Climate Change Risk Assessment (CCRA), as a part of a larger Environmental and Social Impact Assessment (ESIA) – in support of the proposed development of a Liquefied Natural Gas (LNG) Bunkering Project within the Sohar Industrial Port in Oman (hereafter referred to as "The Project"). The Project consists of an onshore plant treating gas to produce LNG, primarily dedicated to LNG bunkering activities, but could also include carriers loading at the Sohar Port in Oman. The LNG plant will be built on reclaimed land protected by an embankment and leased by the Sohar Industrial Port Company (SIPC). The Sohar Industrial Port is situated approximately 220 km northwest of Oman's capital city of Muscat, and the Project site is located just outside of the Strait of Hormuz. The Sohar Port is in a favourable location for trade and cargo handling in and out of the Arabian Gulf, and on a major shipping route between Europe and Asia. For a map of the proposed site location, see Annex 1.

This assessment has been prepared primarily for the regulatory permitting process to align with the Oman Regulations for the Management of Climate Affairs[1]. As outlined in the 'Guidelines for the Preparation of Climate Affairs Chapter in the Environmental Impact Assessment (EIA) Study for the projects', this assessment covers:

- Consideration of climate change risk & vulnerabilities (e.g., temperature, extreme rainfall, storms and high winds etc.).
- Assessment of historical and current climate-related trends;
- Assessment of future projected climate change impacts (using climate scenarios);
- Assessment and prioritisation of key future climate change risks;
- A high-level overview of each of the relevant inherent risks to the Project with associated materiality ratings; and
- A list of recommended next steps/potential mitigation measures for each of the inherent risks identified, which can be used to inform the Project's design, and a complete Climate Affairs Risk Reduction Plan (CARRP) for the Project.

The Client also requires this assessment to align with the Equator Principles 4 (EP4) Guidance Note for CCRA's (initially EP4 published its CCRA guidance in September 2020, which has since been superseded with updated guidance being published in May 2023). This report represents the first of three phases of analysis (referred to as the overall CCRA - see

Figure 2-1 A three phased approach to undertaking physical CCRA's in alignment with EP4 guidance (2023)) required to fully align with the EP4's 2023 guidance and includes the identification and prioritisation (for further assessment and consideration within the Project's design) of risks and opportunities which could be material in relation to the Project. The findings of this report, alongside feedback from the Client, will feed directly into later phases of analysis (e.g. Phase 2 of the overall CCRA as deemed necessary according to EP4 guidance and thresholds) and could be used to inform additional independent assessments and project design being undertaken by TotalEnergies alongside this workstream (such as TotalEnergies' Climate Change Physical Risk design study being developed).

1.1 Scope

Triggers for an EP4 aligned CCRA:

Due to the nature of the construction and operations associated with the Project, it is assumed the proposed Project classification is 'Category A' (according to International Finance Corporation

[1] Omani Ministry of Environment and Climate Affairs (2013).

definitions). EP4 guidance requires all Category A, and as appropriate, Category B projects to undertake a physical CCRA.

Scope 1 and 2 emissions associated with the Project have been calculated, and are not expected to exceed 100,000 tonnes of CO2 equivalent annually with the solar plant constructed as planned (emissions are estimated to equal ~25.4 ktCO2e annually during the operational phase using a base case) meaning that the Client should not undertake a transition CCRA and a GHG alternatives analysis. This report includes the physical risk CCRA, whilst the GHG element of this assessment is included in a separate sub-chapter.

Project facilities and associated facilities:

It is understood that a number of facilities and specific pieces of infrastructure will be constructed (or in the case of the accommodation camps are already in place but will be included) as a part of the Project. Most notably this includes the:

- **LNG Plant:** consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to liquefy the Natural Gas inlet and produce LNG.
- **Top-side elements of the LNG Export Jetty:** the operational area of the jetty topsides will include: a pipe rack, process manifolds, LNG loading arms, safety measures, and a jetty control station.
- **Pipelines and transmission lines:** Comprised of a condensate export pipeline and buried electrical transmission lines.
- **Accommodation camps and other facilities within the area of influence:** The Sohar Port area and Freezone Port Area have already been developed and include: the accommodation camps (associated with the Project) and access roads to the LNG Plant (some of which will be modified for the purpose of the Project).

Similarly, there are also a number of Associated Facilities (AFs) which will be built in support of the Project (referring to any aspects of infrastructure that would not have been constructed or expanded if the Project did not exist, and without which the Project would not be viable). This includes the:

- **OQGN feed gas pipeline:** the existing OQGN network will be extended to feed the LNG Plant with natural gas. Pipeline construction will be performed by an OQGN contractor.
- **The marine component of the Jetty:** the subsea component of the Jetty will be designed and built by Sohar Industrial Port Company (SIPC).
- **The Solar Plant:** A Solar Plant will be constructed by Marsa Solar PV SPV and connected to the existing grid. It is planned that the Solar Plant will provide electricity to the grid, and the LNG plant will consume energy from the grid. The Scope 2 emissions will be considered negated on the basis that sufficient IRECs are generated and provided by the Marsa Sola PV SPV to cover all the electricity consumed (MWh) by the Project. Contractual negotiations to formalise these arrangements are understood to be ongoing at the time of preparing this report.

Each of these key Project facilities and AFs will be considered within this assessment – to ensure a full and representative analysis of the different climate-related risks posed to the Project is undertaken.

Project timeline:

The Project can be split into three distinct phases associated with the construction, pre-commissioning, and commissioning (referred to as ‘Project Phase 1’), operations and maintenance (referred to as ‘Project Phase 2’) and the decommissioning (referred to as ‘Project Phase 3’). Project Phase 1 is anticipated to last for 34 months, with the main construction activities to start in the third quarter of 2024, concluding with the start-up of the plant in mid-2027. The operational phase of the Project is estimated to last for ~25 years – following which the Project will be decommissioned. See Figure 1-1 for a summary of the Project timeline.

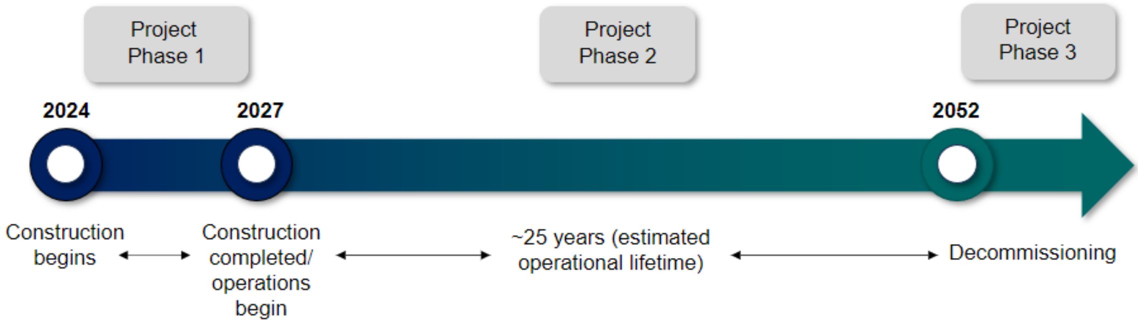

Figure 1-1: Timeline of the Project

2. METHODOLOGY

2.1 Overall EP4-aligned CCRA methodology

A three-phased methodology for undertaking a CCRA in alignment with the EP4's 2023 Guidance Note for CCRAs has been developed. Below is a summary of these three assessment phases:

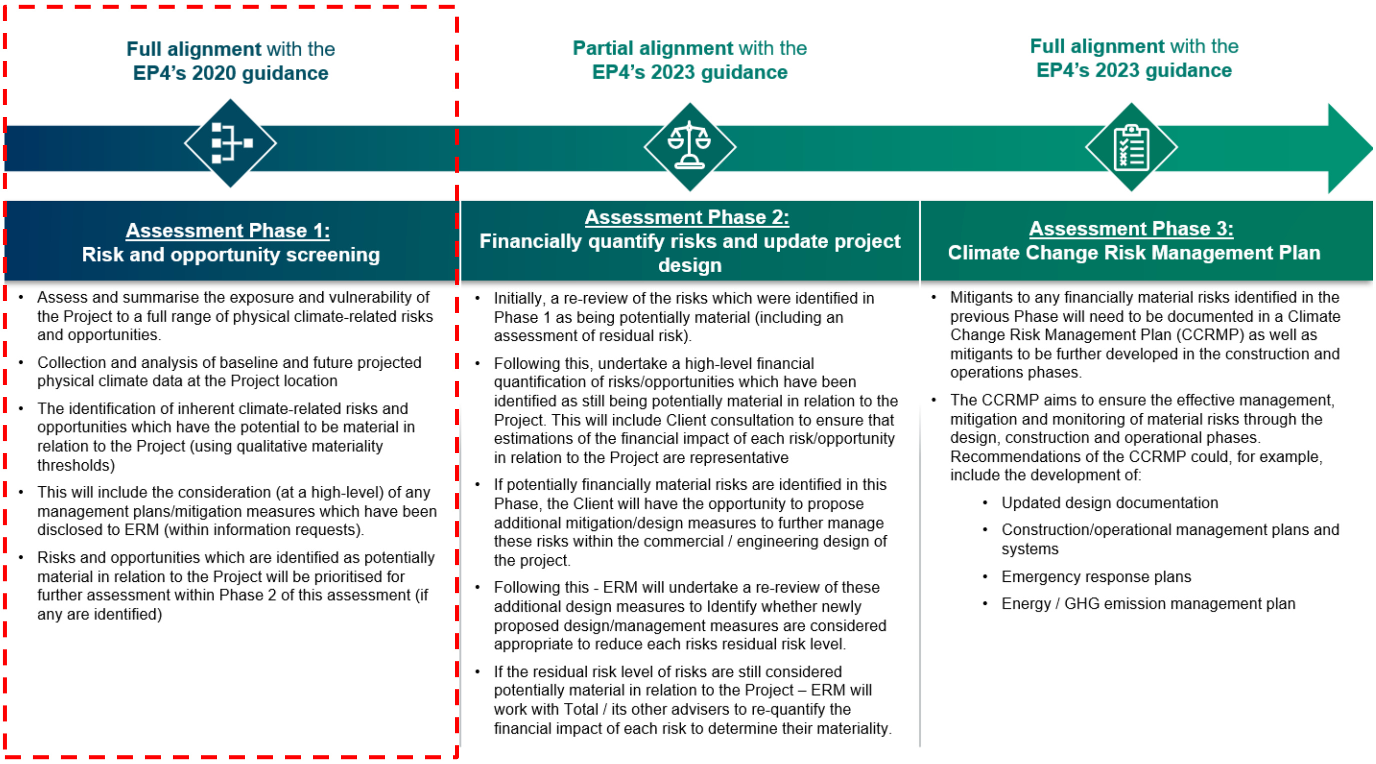

Figure 2-1 A three phased approach to undertaking physical CCRA's in alignment with EP4 guidance (2023)

The scope of this report includes the first phase of this methodology, as highlighted by the red dash box in the Figure above.

2.2 Assessment Phase 1 approach: risk and opportunity screening

Phase 1 (risk and opportunity screening) of this assessment seeks to:

- Identify the presence of climate-related risks and opportunities in relation to the Project;
- Assess how potentially material each risk/opportunity could be in relation to the Project;
- Provide examples of actions which could be taken by the Client to further assess, understand and manage each of the risks which have been identified as potentially material; and
- Inform further phases of assessment.

This Phase 1 of work is split into three tasks:

Task 1a – Review Project exposure and vulnerability

Initially, the exposure of the construction and operational phases of the Project's to a full range of climate hazards was reviewed. To fully inform this review, an Information Request (IR) was issued to TotalEnergies, which sought to gain additional insight from TotalEnergies regarding:

- The Project, its design, exposures and key vulnerabilities to climate change;
- The location and spatial orientation of the assets associated with the Project; and
- Any climate/hazard risk assessments which have already been completed for the Project.

Task 1b – Gather climate data

Climate data was collected, primarily using ERM's Climate Impact Platform (CIP) (and supplemented by additional freely available online sources of data), across the Project's spatial extents for a full range of climate hazards. According to best-practice guidance, including the EP4 and Task Force on Climate-Related Financial Disclosures (TCFD), forward looking CCRA's should assess the potential impact of climate change in relation to a Project under a variety of plausible 'futures'. As a result, this assessment incorporates climate data for two potential future scenarios – termed Shared Socio-Economic Pathways (as defined by the Intergovernmental Panel on Climate Change – IPCC. See Annex 2 for a more detailed summary).

These scenarios are:

- **SSP1-2.6 (referred to as the low emissions scenario in this report):** A low emissions scenario that stays below 2°C warming by 2100, aligned to the current commitments under the Paris Agreement; and
- **SSP5-8.5 (referred to as the high emissions scenario in this report):** A high emissions scenario which follows a 'business as usual' trajectory, assuming no additional climate policy and a mean annual temperature increase by 2100 compared to pre-industrial averages of +4.4°C compared to pre-industrial levels.

Similarly, climate data was collected across a range time horizons (See Annex 2 for a more detailed summary), including:

- **Baseline:** used to represent the current level of risk posed during the construction phase of the Project;
- **2030:** used to represent the level of risk posed to the Project at the beginning of the operational phase of the Project; and
- **2050:** used to represent the level of risk posed to the Project at the end of the operational phase of the Project.

Task 1c – Identify, assess and screen inherent risk/opportunity

Based upon the previously collected data, an analysis of the baseline and future projected trends associated with each climate hazard was undertaken. As a part of this process, it was identified which hazards are currently, or anticipated to become, present across the Project's spatial extents and have the potential to pose a risk, or opportunity, to the Project's construction and/or operational phase. For each of these hazards a risk review was undertaken – to qualitatively assess how material each of their associated risks/opportunities could be in relation to the Project.

Initially, as a part of the risk review section, a longlist of risks and opportunities were developed for each hazard. Following this each risk/opportunity was assigned a 'risk area' (the specific part of the Project or surrounding environment which could be at risk – see Table 2-1) and an impact category (highlighting the primary impact of each risk/opportunity in relation to the Project/Client – see Table 2-2).

Table 2-1 Definitions of the potential risk areas to the Project

Risk area	Definition and extent of the risk area
Access routes	Access routes which are expected to be used during the construction and/or operational phase of the Project. This includes access routes that will be constructed as a part of the Project, or are considered as an AF.
Electricity supply (including the Solar Plant)	This refers to all aspects of infrastructure which will be responsible for the supply of electricity to the Project. This includes the transmission lines (buried electrical cable), the LNG substation (which fall within the scope of the Project) and the Solar Plant (which is an AF to the Project).
LNG plant	Consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to liquefy the Natural Gas inlet and produce LNG
Jetty	This refers to all aspects of the Jetty which are considered within the Project's scope (e.g. the Jetty topside, including: the pipe rack, process manifolds, LNG loading arms, safety measures and the jetty control station), or as an associated facility to the Project (e.g. the marine aspect of the Jetty).
Pipelines	This includes all pipelines which fall under the Projects scope (condensate export pipeline), or are considered an AF (OQGN feed gas pipeline) - and are identified as vital to the Projects operations.
Site personnel	Any person working on-site during the construction and/or operational phase of the Project.
Water supply	This includes all water inputs to the Project from local water supply network infrastructure which will be supplied from the Port Sohar facilities (who provides potable water) and the Majis Industrial Services Company (who provide industrial and potable water to port tenants).
Local communities/environment	This includes the environment (e.g. habitats and wildfire) and local communities living in the area surrounding the Project, who could be impacted by the Project's operations.

Table 2-2 Definitions of the impact categories for potential risks to the Project

Impact category	Definition
Direct impacts to the Project / indirectly to lenders:	
Operational expenditures (OpEx)	An expense that a business incurs through its normal business operations.
Capital expenditures (CapEx)	Includes the cost of fixed assets such as property, plant and equipment, and intangible assets such as patents.
Revenue	Income arising in the course of an entity's ordinary activities (returns, allowances and discounts) - before deducting costs for the goods/services sold and operating expenses to arrive at profit.
Impacts of the Project:	

Local communities and/or environment	Defined as the effect that the construction/operational use of the Project has on local communities and/or the local environment. Examples could include water contamination and air pollution (and the potential negative impact on the surrounding community), and disruptions to ecosystems.
Reputational	Defined as the negative impact on a business as a result of failing to meet stakeholder expectations. Stakeholders could include consumers, surrounding businesses, regulators, and local communities.

2.2.1 Climate Change Risk Reduction and Adaptation Plan

Although the Client has identified a number of management measures in relation to the Project (which have been considered at a high level within this report), as these are still being designed/developed, an assessment of the residual level of risk posed to the Project (i.e. how material a physical risk could be when considering implemented management/mitigation measures) has not been undertaken. Instead, this assessment considers the inherent level of risk posed to the Project by each physical risk (i.e. how material a physical risk could be in the absence of management/mitigation measures) – through the assignment of ‘Inherent Risk Materiality Ratings’ across different time horizons associated with the Project (see Table 2-3 for a summary of these inherent risk materiality ratings). Following this, a series of recommend next steps were also provided for each risk - highlighting examples of actions which could be taken by the Client to further assess, understand and manage each of the risks which have been identified as potentially material.

Table 2-33 Inherent risk materiality ratings and associated definitions

Inherent Risk Materiality Rating		Definition
Unlikely material		The impacts associated with risks/opportunities that are assigned this rating are unlikely to be material to the Project. This means that, for example, (a) operational impacts could be expected to be short term, impacting a limited proportion of the overall asset and its operations, or (b) financial impacts would be expected to be minimal relative to the Project’s overall revenue and/or costs.
Likely Material	**Low**	The impacts associated with risks/opportunities that are assigned this rating (such as those related to operational, financial or other types of impacts) are likely to be of low materiality. This means that, for example, (a) operational impacts could be expected to be short to medium term, impacting a small proportion of the overall asset and its operations, or (b) financial impacts would be expected to be small relative to the Project’s overall revenue and/or costs.
	Moderate to High	The impacts associated with risks/opportunities that are assigned this rating (such as those related to operational, financial or other types of impacts) are considered likely to be of moderate to high materiality. This means that, for example, (a) operational impacts could be expected to be medium to long term, impacting a low to high proportion of the overall asset and its operations, and/or (b) financial impacts would be expected to be moderate to high relative to the Project's overall revenue and/or costs.

2.2.2 Monitoring, Follow Up and Adaptive Management

As the Project is still in the design phase - it is recommended that all potentially material risks (and associated findings) identified within this report are reviewed in further detail within follow-on phases of assessment (with particular consideration being given to the most material risks – as listed in the table above).

2.3 CCRA limitations and assumptions

It should also be noted that there are a number of limitations and assumptions associated with this assessment – which should be considered when interpreting this reports' findings. These include:

- This is a fully desk-based assessment, and is not based on any on-site visits, and thus assessments of the exposure of each asset are based upon information provided by the Client.
- The accuracy of information provided by the Client has not been verified (for example design specifications, observational data provided etc.).
- This high-level screening exercise and its corresponding recommendations should be considered as a first step for further assessment and consideration.
- This report will not include an assessment of the potential impact of seismic activity (e.g. earthquakes) on the Project and its operations as these events are associated with, and induced by, seismic activity and therefore not considered a physical climate change event/hazard**.**
- A review of the Project's supply or full value chain has not been undertaken, and therefore there may be impacts not covered in this CCRA relevant to the Project.
- Climate data has been collected across a series of coordinates associated with the Project's operational footprint (according to the information provided within the Client's Project Description). The climate data presented within this report represents the maximum risk result obtained across the Project's operational footprint.

3. TRENDS ANALYSIS AND RISK REVIEW

3.1 Project area climate

The Project is located in the Sohar industrial port in Northern Oman, just outside of the Strait of Hormuz. Oman has a subtropical, dry climate with summer monsoons and hot, dusty winds[2]. The hot season in Sohar is from May to September with mean temperatures ranging from 31 to 33°C, whilst the cold season lasts from December to February with temperatures ranging from 20 to 21°C. The rainy period lasts from February to March with an average monthly rainfall of 13mm. May to October are noted as the driest months with average monthly rainfall being recorded between 1.5 and 2.2 mm. It is noted that Oman has also been subject to impacts from tropical depressions and tropical cyclones in recent decades - which typically occur during the pre and post monsoonal months (May/June and October/November).

3.2 Hazards carried through to risk review

Climate data is provided in the tables below for each hazard grouping. This climate data is provided under baseline and future projected climatic conditions. Definitions of each climate variable can be found in Annex 3. The following hazards have been carried through to the risk review as they are anticipated to have the potential to pose material risks to the Project: extreme heat, flooding, extreme winds, wildfires and water stress and drought. Extreme cold and landslides have been screened out of this assessment – as they are not deemed as being likely to pose material risk to the Project (see Table 3-11 for specific justification for each hazard).

3.2.1 Extreme heat

Trends analysis:

Baseline and projected climate data for extreme heat are summarised in Table 3-1 Baseline and projected extreme heat climate data, and described below.

Projections indicate an increase in mean daily maximum temperatures, from a baseline of 34.3°C by:

- +0.9°C to 1°C by 2030; and
- +1.5°C to 2°C by 2050,
  for a lower and higher emissions scenario respectively.

According to the US National Weather Service's classification for apparent temperature thresholds, baseline mean daily maximum temperatures are already recorded above the threshold for 'extreme caution' for human health[3].

The highest daily maximum temperature (i.e. the highest of all maximum daily temperatures per annum) is projected to increase from the baseline of 47.5°C by:

- +1.1°C to +1.2°C by 2030; and
- +1.9°C by 2050.

The warm spell duration index (WSDI - the annual count of days contributing to "warm spells" when the maximum temperature remains above a regions climatological 90th percentile) is projected to increase from a baseline of 31.4 days:

- by +55.7 days to +61.3 days by 2030; and

[2] Oman - Climatology | Climate Change Knowledge Portal (worldbank.org)

[3] Garland et al. (2015), Regional Projections of Extreme Apparent Temperature Days in Africa and the Related Potential Risk to Human Health. Available at: Regional Projections of Extreme Apparent Temperature Days in Africa and the Related Potential Risk to Human Health - PMC (nih.gov).

- +62.4 days to +137.5 days by 2050,

  for a lower and higher emissions scenario respectively.

These trends are significant and indicate a much higher occurrence of the number of days per annum where temperatures are abnormally high.

The annual number of days where apparent temperatures exceed 51°C is projected to increase from a baseline of 24.5 days by:

- +20.5 days to +14.5 days by 2030; and
- +23 days to +54 days by 2050.

This variable represents the temperature, as it is 'feels' to humans, combining the effects of air temperature, relative humidity and wind speed (being particularly relevant to human-related risks). As extreme heat conditions are already present and projected to increase under future timeframes/scenarios, this hazard has the potential to pose material risks to the Project. As a result this hazard has been carried through to the risk review.

Table 3-1 Baseline and projected extreme heat climate data

Variable	Baseline	Projections			
		2030		2050	
		Lower emissions	Higher emissions	Lower emissions	Higher emissions
Mean daily maximum temperature (°C)	34.3	35.2	35.3	35.8	36.3
Maximum daily maximum temperature (°C)	47.5	48.6	48.7	49.4	49.4
Warm spell duration index (WSDI) (days)	31.4	87.1	92.7	93.8	168.9
>51°C Apparent temperature days (days)	24.5	45.0	39.0	47.5	78.5

Risk review:

The below risk review outlines potential risks posed to the Project by extreme heat. As summarised in Table 3-2 Extreme heat inherent risk materiality ratings, each risk which has been identified has been assigned a risk area, impact category and an inherent risk materiality rating for:

- the construction/start-up phase;
- the beginning of operational phase; and
- the end of operational phase of the Project.

Similarly, a series of recommended steps have also been provided for each risk for review within follow-on phases of assessment.

Table 3-2 Extreme heat inherent risk materiality ratings

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction /Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
EXH1	Site Personnel	Revenue OpEx	Likely Material - Low	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EXH2	LNG Plant	Revenue	Unlikely Material	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EXH3	LNG Plant	CapEx OpEx	Unlikely Material	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EXH4	Pipelines	CapEx	Unlikely Material	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EXH5	Pipelines	Local communities/ environment Reputational	Unlikely Material	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EXH6	Electricity Supply (including the Solar Plant)	Revenue OpEx	Likely Material - Low	Likely Material – Low	Likely Material – Low	No

Description of potential impacts:

EXH1 – Extreme heat impacts on site personnel health and safety

Extreme heat events have the potential to pose risks to the health and safety of personnel working on-site during the construction and operational phases of the Project. With increased temperatures, personnel could experience dehydration, heat stress, heat exhaustion and, in severe cases, heat stroke. Apparent temperatures >51°C make heat stroke highly likely, therefore the significant projected increases in occurrence of days above this threshold, increase the chance of these risks. To maintain comfortable working conditions, it may be necessary to increase the usage of air conditioning units, which could lead to an increase in OpEx. In a worst-case scenario, a larger workforce may be required to accommodate additional breaks for site personnel and/or shift patterns may need to be introduced to avoid extreme temperatures, similarly leading to increases in OpEx.

Extreme heat events could also result in personnel requiring additional breaks, water, and access to shaded areas – which has the potential to reduce operational efficiency throughout each phase of the Project. For the construction phase, reductions in operational efficiency could cause delays to the proposed completion date of the LNG plant and associated infrastructure which could potentially lead to reduced revenues (and increased OpEx) as the construction time may increase. During the operational phase there may also be delays to maintenance and other site operations if the operational efficiency of site personnel decreases due to heat-related impacts, further potentially reducing projected revenues.

As a result of the risk review above – the inherent risk materiality rating assigned to the construction/start-up phase of the Project is ‘Likely Material – Low’. During the operational lifetime of the Project, site personnel are anticipated to be involved with maintenance or repair work and will, therefore, remain exposed to risks associated with extreme heat. However, as some of the risks associated with extreme heat are anticipated to rise during the operational phase of the Project (due to an increase in the number of >51°C apparent temperature days), the inherent risk materiality category has been elevated to ‘Likely Material – Moderate to High’ for the beginning of the operational phase and the end of operational phase.

It is noted that prior to operations starting, contractors are required to submit Health, Safety and Environmental (HSE) plans regarding specific risks associated with the Project (which are subject to TotalEnergies’ approval) – these documents will have to include the specific consideration of climate hazards (e.g. extreme heat). However, this management measure is not already developed and therefore not considered as influencing the assigned inherent risk materiality ratings.

EXH2 & EXH3 – Extreme heat impacts on the LNG plant

The natural gas liquefication process requires natural gas to be cooled to extremely low temperatures (approximately ~-150°C) in the liquefication unit, consisting of a cryogenic heat exchanger. During extreme heat conditions, the efficiency of the heat exchanger may decrease as heat dissipation becomes less efficient under higher ambient temperatures. Equipment performance may also decrease as higher temperatures can lead to mechanical issues and reduced efficiency for machinery in the LNG plant. Both factors can lead to a reduced production capacity of LNG, which could in turn, reduce revenue generation during the operational phase of the Project.

The natural gas liquefaction process is also highly energy intensive. During extreme heat conditions, the ambient temperature will be higher, which means cooling systems (e.g., the air-based cooling system) will need to consume more energy to sufficiently reduce the temperature of the gas to approximately ~-150°C. This can lead to increased OpEx associated with energy use during the operational phases of the Project. Additionally, as previously mentioned, an increased occurrence of mechanical issues during periods of extreme temperatures may also increase the CapEx required for repairs and maintenance.

As maximum temperatures are projected to increase, along with the number of unusually hot days annually, these impacts are likely to worsen during the lifetime of the Project. This risk has the potential to cause disruption to operations and revenue generation, therefore potentially increasing OpEx and CapEx. As it is not known if operations could continue at normal capacity during extreme heat conditions, the inherent risk materiality rating assigned to the beginning and end of the operational phase of the Project is ‘Likely Material – Moderate to High’. However, as the LNG plant will not be undertaking the liquefaction process during the construction phase, an inherent risk materiality rating of ‘Unlikely Material’ has been assigned to the construction/start-up phase.

EXH4 & EXH5 – Extreme heat impacts on pipelines

Extreme heat can lead to the expansion of pipelines which can cause structural stress, cracks, buckling and ruptures leading to gas leaks and, in a worst-case scenario, pipeline failures. There is also an increased risk of material degradation and damage to coatings from exposure to direct heat and sunlight. This could lead to additional CapEx for maintenance and repairs, if required. In the short-term, these impacts will be much more likely to affect above-ground pipelines compared to buried pipelines, as buried pipelines are not directly exposed to extreme air temperatures.

However, prolonged exposure to extreme heat may also impact buried pipelines via ground settlement which could place additional stress on the pipeline, pipeline movement, and damage to pipeline supports. This risk may be somewhat mitigated by pipes being buried in engineered, reclaimed land. As projections show an increase in the duration of extreme heat events, and an increase in average and extreme temperatures, it is likely that these impacts will become more frequent over the lifetime of the Project.

In addition to pipeline damage causing potential financial impacts to the Client, environmental issues could also arise if gas were to leak from damaged pipes (e.g. there could be ground contamination which could harm local ecosystems, or air pollution as methane is a greenhouse gas). These impacts could lead to reputational issues as well as costs associated with remediation.

Based on the information discussed above the inherent risk materiality rating assigned to the beginning and end of the operational phase is 'Likely Material – Moderate to High'. However, as the pipelines will only be in use by the Project during the operational phase, the inherent risk materiality rating assigned to the construction/start-up phase is 'Unlikely Material'.

EXH6 - Extreme heat impacts on electricity supply (including the Solar Plant)

Extreme heat has the potential to cause a range of impacts to the electricity supply associated with the Project. In the future, increasingly extreme temperatures could place additional strain on heat-sensitive aspects of infrastructure (e.g. substations), increasing the risk of damage and malfunction – which could impact the supply of electricity to the LNG plant. This in-turn could disrupt LNG production and require the use of backup national grid power (instead of the proposed Solar Plant which is anticipated to supply 100% of electricity to the LNG plant), which could increase OpEx. It should be noted that although extreme heat could also pose risks to the electrical transmission cables associated with the Project, this is deemed less likely as electrical transmission cables associated with the Project are anticipated to be buried underground – reducing their exposure to extreme temperatures.

With projected increases in extreme heat conditions in the future, an increase in the risk of dust pollution in the Project region could occur, which could in-turn reduce the efficiency and solar energy yield of the Solar Plant (recent studies indicate that dust accumulation can impact solar outputs by up to 30%). This in-turn could potentially increase PV plant OpEx due to additional dust cleaning requirements, although this will not directly impact the LNG plant itself.

Based upon the analysis above – the inherent risk materiality category assigned to the construction/start-up phase, beginning and end of the operational phase is 'Likely Material – Low'.

Recommended next steps:

Based upon these risks potential to cause material impacts to the Project, it is recommended that the Client undertakes a more detailed assessment of extreme heat conditions in relation to the Project (and its associated assets and operations). It should also be noted that the implementation of mitigation measures/management plans could potentially reduce the materiality of these risks in relation to the Project. Therefore, it has been identified that there is potential value in the Client assessing/ managing each of these risks further. Below are a series of examples of how this could be achieved:

- **EXH1** – Ensure the HSE plans submitted by contractors are sufficient to protect the health and safety of site personnel during periods of extreme heat e.g., ensure personnel have adequate shaded areas to protect them from the sun; ensure personnel have sufficient access to water throughout the day; implement adjusted working schedules to avoid working through the hottest parts of the day.

- **EXH2** – Ensure that design specifications of equipment (e.g., cryogenic heat exchanger) allows operation at design capacities under projected extreme heat conditions.

- **EXH3** – Assess the operational efficiency and resilience of the cryogenic heat exchanger under extreme heat conditions. Ensure routine maintenance to machinery which may deteriorate under higher temperatures is undertaken prior to the hot season.

- **EXH4 & EXH5** – Ensure design specifications account for the potential impacts of extreme heat on pipelines to ensure operational resilience, considering for example, materials, insulation, continuous monitoring of pipeline conditions, maintenance of pipeline coatings etc.

- **EXH6** – Communicate the risks identified within this report to the third-party contractor responsible for the construction of the Solar Plant, to ensure that these risks are considered within the design of the Solar Plant (to ensure that this risk is managed effectively to reduce its potential impacts on the Project). Review the design specifications of substations against extreme temperatures within the Project region, to ensure that they are sufficiently resilient.

- It is also recommended that all risks (as listed above) are reviewed in further detail within follow-on phases of assessment, with particular consideration being given to the most material risks identified within this assessment – **EXH1 to EXH5**.

3.2.2 Flooding

Trends analysis:

The Project is located in direct proximity to the Gulf of Oman, increasing the Project's susceptibility to coastal flooding. While there are two rivers close to the Project location – Wadi Bani Umar and Wadi Dhibyan – wadis are typically dry in nature, unless there has been rainfall in the area. The climate data analysed within this section (see Table 3-3 Baseline and projected flooding climate data) suggests risks associated with river flooding are limited across all time horizons and scenarios, and therefore coastal flooding and extreme rainfall flooding is the focus of this section.

Projections indicate an increase in extreme rainfall flooding inundation depths, from a baseline of 0.30m by:

- +/-0cm to -3cm by 2030; and
- +6cm to -2cm by 2050,

  for a lower and higher emissions scenario respectively.

For coastal flooding, projections indicate an increase in coastal flooding inundation depths, from a baseline of 1.76m by:

- +18cm to +19cm by 2030; and
- +32cm to +38cm by 2050,
  for a lower and higher emissions scenario respectively.

Thes results indicate that coastal flooding, and to a lesser extent, extreme rainfall flooding, both have the potential to pose material risks to the Project, and therefore these hazards have been carried through to the risk review section.

Table 3-3 Baseline and projected flooding climate data

Variable	Baseline	Projections			
		2030		2050	
		Lower emissions	Higher emissions	Lower emissions	Higher emissions
1-in-500-year coastal flood depth (m)	1.76	1.94	1.95	2.08	2.12
1-in-500-year extreme rainfall flood depth (m)	0.30	0.30	0.27	0.36	0.28
1-in-500-year river flood depth (m)	0.00	0.00	0.00	0.00	0.00

Risk review:

The below risk review outlines potential risks posed to the Project by flooding. As summarised in Table 3-4 Flooding inherent risk materiality ratings, each risk which has been identified has been assigned a risk area, impact category and an inherent risk materiality rating for:

- the construction/start-up phase;
- the beginning of operational phase; and
- the end of operational phase of the Project.

Similarly, a series of recommended steps have also been provided for each risk for review within follow-on phases of assessment.

Table 3-4 Flooding inherent risk materiality ratings

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction/ Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
FL1	LNG Plant	Revenue Local communities/ environment	Likely Material – Moderate to High	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
FL2	Jetty	CapEx Revenue	Likely Material – Moderate to High	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
FL3	Site Personnel	Revenue	Likely Material – Low	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
FL4	Electricity supply (including Solar Plant)	CapEx Revenue Reputational	Likely Material – Low	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
FL5	Pipelines	CapEx Revenue Local communities/ environment	Unlikely Material	Likely Material – Low	Likely Material – Low	No

Description of potential impacts:

FL1 – Flooding impacts on the LNG plant

The 1-in-500-year coastal flooding depth during the construction period is projected to range from 1.76 and 1.95 metres. Considering the EU JRC Global flood depth-damage functions[4] (using values for industrial sites in Asia as a proxy), this corresponds to a damage factor of ~0.6 to 0.7 (this value can range from 0 to 1 – with 0 equating to no damage and 1 equating to total loss). This indicates the potential for significant damage as a result of flooding for this phase of the Project. Flooding could also lead to significant delays to the proposed completion date of the LNG plant and associated infrastructure which could lead to lost revenue (and increased OpEx) as the required construction time may increase. Due to the location of the Project and the potential for significant flood depths/damage, the inherent risk materiality rating assigned to the construction/start-up phase of the Project is 'Likely Material – Moderate to High'.

As the Project moves into the operational (and end of operational) phase, coastal and extreme rainfall flooding could lead to disruptions to LNG production if equipment becomes damaged, if conditions on site are not safe for personnel, or if unsafe conditions lead to shut-ins. Similarly, if damage was incurred to the LNG plant as a result of flooding, toxic chemicals could leak into the surrounding environment – posing risks to the environment and surrounding communities (e.g. there may be ground contamination which can harm ecosystems).

As the 1-in-500-year flood depth is projected to increase for both extreme rainfall flooding and coastal flooding which could lead to even more severe impacts in the future – the inherent risk materiality rating assigned to the beginning, and end of the operational phase of the Project remains 'Likely Material – Moderate to High'.

FL2 – Coastal flooding impacts on the jetty

Coastal flooding (and associated sea level rise and storm surges) could cause severe disruptions to the construction phase of the jetty if the land portion of the construction site is inundated and conditions are not suitable for construction activities to take place (e.g., if the area is not accessible by vehicles, or if there are health and safety concerns for personnel). This could lead to significant delays to the proposed completion date of the jetty, which is a crucial aspect of infrastructure for the Project's operations, therefore potentially leading to lost revenue and increased OpEx as the completion date of the construction phase could be extended.

During the operational phase of the Project, coastal flooding and sea level rise could cause potential damage to the jetty's structural components or equipment and machinery through increased stresses and force from storm surges and waves. This could lead to increased CapEx being required for repairs and maintenance works. Coastal flooding caused by storm surges, tropical cyclones and storms could also lead to unsafe loading conditions at the jetty which could lead to the halting of operations. This could lead to downstream supply chain disruptions such as delivery delays for purchased goods and revenue losses for the Client if LNG bunkering is disrupted, particularly if this is for a significant period of time.

Due to the location of the Project and the potential for significant flood depths under baseline and future conditions, the inherent risk materiality rating assigned to the construction/start-up, and beginning/end of the operational phases is 'Likely Material – Moderate to High'.

FL3 – Flooding impacts on site personnel

Coastal and extreme rainfall flooding have the potential to pose health and safety risks to personnel working on site during the construction and operational phases of the Project. Floodwaters may be contaminated by pathogens, wastewater and sewage which could cause a range of infectious diseases.

[4] Huizinga, J., De Moel, H. and Szewczyk, W., Global flood depth-damage functions: Methodology and the database with guidelines, EUR 28552 EN, Publications Office of the European Union, Luxembourg, (2017) [JRC Publications Repository - Global flood depth-damage functions: Methodology and the database with guidelines (europa.eu)]

Extreme rainfall and flooding could also cause an increase in slip hazards, standing water, and safety issues if water came into contact with electrical equipment.

These impacts have the potential to reduce the productivity of site personnel, particularly if it is not safe for site personnel to remain on site, which could cause delays to the Project's completion date, and delay the start of LNG production (and revenue generation). As a result, the inherent risk materiality rating assigned to the construction/start-up phase is 'Likely Material – Low'.

During the operational lifetime of the Project, site personnel are anticipated to be involved with maintenance or repair work and will, therefore, remain exposed to risks associated with flooding. However, as flood depths are anticipated to increase significantly in the future/during the operational phase of the Project, the level of risk posed to site personnel (e.g., health and safety risks and risks of operational disruption) could also increase. As a result, the inherent risk materiality category has been elevated to 'Likely Material – Moderate to High' for the beginning, and end of the operational phase.

It is noted that prior to operations starting, contractors are required to submit Health, Safety and Environmental (HSE) plans regarding specific risks associated with the Project (which are subject to TotalEnergies' approval) – these documents will have to include the specific consideration of climate hazards (e.g. flooding). However, this management measure is not already developed and therefore not considered as influencing the assigned inherent risk materiality ratings.

FL4 - Flooding impacts on electricity supply (including the Solar Plant)

Coastal / extreme rainfall flooding has the potential to cause damage to key components of the electricity supply associated with the construction phase of the Project (e.g., diesel-powered generators). For example, electrical components (of the generators and associated transmission equipment) could be damaged if this equipment is exposed to excess water, increasing CapEx for repairs. Damage to electrical equipment could also lead to a reduction in the efficiency of equipment, or in a worst-case scenario, cause equipment failure, both of which could cause delays to the Project's completion date (and therefore Project revenue generation).

During the operational phase of the Project, above ground infrastructure (e.g. substations and the Solar Plant) may also be subject to physical damage from flooding (e.g. inundation of substations/the Solar Plant could cause electrical faults and malfunction) – which could require an increase in CapEx for repairs and cause disruption in electricity supply to the Project (potentially reducing revenue generation). CapEx associated with repairs may be particularly high if coastal flooding occurs – due to the particularly corrosive nature of salt water which could lead to an increase in damage to electrical infrastructure (which in-turn could cause longer periods of operational downtime due to intensive cleaning processes).

The Solar Plant associated with the Project will provide electricity to the grid, and the LNG plant will consume energy from the grid. If damage to the Solar Plant from flooding prevented electricity generation, while this would not disrupt operations (as electricity would still be supplied by the grid itself), this could cause significant reputational impacts if the Project's Scope 2 emissions are not covered by matching IRECs because the plant is not operational.

As the Project is anticipated to source its energy from on-site diesel generators during the construction phase (and therefore implications to CapEx / revenue are limited at this stage as the Project is not yet operational), the inherent risk is identified as 'Likely Material – Low' under baseline conditions. However, as the Solar Plant and LNG Plant become operational, the potential reputational risk when considering the potential non-performance of the Solar Plant to provide IRECs to cover the Project's Scope 2 emissions means that the assigned inherent risk materiality rating increases to 'Likely Material – Moderate to High' for the start and end of the operational phase.

FL5 – Flooding impacts on pipelines

Under and overground pipelines related to the Project are at risk of physical damage from coastal and extreme rainfall flooding. Floodwaters could cause land instability and subsidence which could, in turn, damage the pipelines and cause gas leaks. Damage to the pipelines (and electrical equipment at pumping stations) could cause disruption to the steady supply of gas to the LNG plant and require additional CapEx to accommodate repairs.

Coastal and extreme rainfall flooding (as well as storm surges) could also lead to the inundation of above ground pipelines could increase the speed of pipeline degradation and weathering. This may require additional maintenance, repairs and associated CapEx to ensure pipeline components are safe/functioning appropriately (e.g., through pipeline reinforcement with composite wraps or repair sleeves). In addition to pipeline damage causing potential financial impacts to the Client, there could also be environmental issues if gas were to leak from damaged pipes (e.g. there may be ground contamination which could harm ecosystems and air pollution as methane is a greenhouse gas). As a result, the inherent risk materiality rating assigned to the start of the operational phase, and end of the operational phase is 'Likely Material – Low'. As the pipelines will only be used by the Project during the operational phase – the inherent risk materiality rating assigned to the construction/start-up phase is 'Unlikely Material'.

Recommended next steps:

Based upon these risks potential to cause material impacts to the Project, it is recommended that the Client undertakes a more detailed assessment of flood risk in relation to the Project (and its associated assets and operations). It should also be noted that the implementation of mitigation measures/management plans could potentially reduce the materiality of these risks in relation to the Project. Therefore, it has been identified that there is potential value in the Client assessing/ managing each of these risks further. Below are a series of examples of how this could be achieved:

- **FL1 & FL3 to FL5 –** Consider the installation of flood defences at the site to protect infrastructure and personnel from flood related risks.
- **FL2 –** Further assessment into whether the design specifications of the jetty and associated infrastructure are sufficient to withstand future projections of sea level rise and coastal flooding.
- **FL3 -** Ensure the HSE plans submitted by contractors are sufficient to protect the health and safety of site personnel during flooding events e.g., having flooding emergency response plans and guidance for staff to follow during flood events in place.
- **FL4 –** Undertake further assessment into the proposed drainage system for the Solar Plant, and the overall resilience of the Solar Plant design to projected flood events.
- **FL5 –** Undertake a further assessment into the resilience of the pipelines which are due to be constructed as a part of the Project and ensure practical measures are taken to reduce the impacts of flooding on pipelines (e.g., ensure coatings are efficient at protecting pipelines from corrosion).
- It is also recommended that all risks (as listed above) are reviewed in further detail within follow-on phases of assessment, with particular consideration being given to the most material risks identified within this assessment - **FL1** to **FL4**.

3.2.3 Extreme winds

Trends analysis:

Baseline and projected climate data for extreme winds are summarised in Table 3-5 Baseline and projected extreme winds climate data, and described below.

Projections indicate an increase in maximum sustained windspeeds (associated with tropical cyclones), from a baseline of 70.0 knots by:

- +4.1 knots to +4.4 knots by 2030; and
- +4.7 knots to +6.6 knots by 2050

for a lower and higher emissions scenario respectively.

As demonstrated above, maximum sustained windspeeds within the Project region are projected to increase across all future timeframes and scenarios, with the largest projected increase by 2050 under a high emissions scenario.

According to the National Oceanic and Atmospheric Administration (NOAA), wind speeds of this magnitude are understood as having the potential to be very dangerous to people and have the potential to cause damage to structures and facilities[5]. Damages could include roof/gutter damage to well-constructed frame homes (which could impact site personnel), or extensive damage to power lines and poles which could likely result in power outages that could last a few to several days (which could impact Project construction/operations).

There is also evidence that destructive tropical depressions, tropical cyclonic storms and severe cyclonic storms have reached Oman in recent decades from the north Indian Ocean and the Arabian Sea. Such storms typically occur during the pre-monsoonal period (May – June) and the post-monsoonal period (October – November)[6]. In recent years, the areas that are at risk from storms have increased almost tenfold in the Muscat area, while Al Wusta is anticipated to be in the region most vulnerable to tropical cyclones in the future[7]. Although the location of the Project is approximately 220km from Muscat, it is anticipated that extreme winds could still pose a potentially material risk to the Project. Additionally, Oman is susceptible to sand/dust storms[8], which could pose additional potentially material risks to the Project.

Table 3-5 Baseline and projected extreme winds climate data

Variable	Baseline	Projections			
		2030		2050	
		Lower emissions	Higher emissions	Lower emissions	Higher emissions
Maximum sustained windspeed (knots)	70.0	74.1	74.4	74.7	76.6

Risk review:

The below risk review outlines potential risks posed to the Project by extreme winds. As summarised in Table 3-6 Extreme winds inherent risk materiality ratings, each risk which has been identified has been assigned a risk area, impact category and an inherent risk materiality rating for:

- the construction/start-up phase;
- the beginning of operational phase; and
- the end of operational phase of the Project.

Similarly, a series of recommended steps have also been provided for each risk for review within follow-on phases of assessment.

5 Saffir-Simpson Hurricane Wind Scale (noaa.gov)
6 Oman - Climatology | Climate Change Knowledge Portal (worldbank.org)
7 Climate Resilience for Energy Transition in Oman – Analysis - IEA
8 Oman - Vulnerability | Climate Change Knowledge Portal (worldbank.org)

Table 3-6 Extreme winds inherent risk materiality ratings

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction/ Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
EW1	LNG Plant	Revenue OpEx	Likely Material – Moderate to High	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EW2	Jetty	Revenue OpEx	Likely Material – Moderate to High	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EW3	Electricity Supply (including the Solar Plant)	OpEx Reputational	Likely Material – Low	Likely Material – Moderate to High	Likely Material – Moderate to High	Yes
EW4	LNG Plant	CapEx	Likely Material – Low	Unlikely Material	Unlikely Material	No
EW5	Jetty	CapEx	Likely Material – Low	Unlikely Material	Unlikely Material	No
EW6	Access Routes	Revenue	Unlikely Material	Unlikely Material	Unlikely Material	No
EW7	Site Personnel	Revenue	Unlikely Material	Unlikely Material	Unlikely Material	No

Description of potential impacts:

EW1 & EW2 – Extreme wind impacts on the LNG plant and jetty (revenues)

During the construction phase of the Project, extreme winds could lead to significant delays in the proposed completion date of the LNG plant/jetty and associated infrastructure which could lead to lost revenue (and increased OpEx) as the duration of construction may increase.

Extreme winds could also lead to unsafe working conditions at the LNG plant/jetty – for example: if there is flying debris, destruction of infrastructure, or if windspeeds are too high for the loading of cargo ships. This could lead to shut-ins whilst conditions are unsuitable for working, and subsequent revenue losses if production were to be suspended, or LNG could not be shipped. The suspension of LNG shipping due to tropical cyclones has previously been experienced in other regions of Oman (e.g. Port Sultan - ~220km from Sohar[9]) - indicating the potential for this hazard to impact the Project. Extreme winds can also lead to unsafe working conditions along shipping lanes which could act to further disrupt the transport of LNG, creating downstream supply chain disruption.

Extreme winds associated with tropical cyclones could also cause disruptions to processes upstream from the LNG operations – which could reduce the Project's production of LNG and revenue.

[9] Climate Resilience for Energy Transition in Oman – Analysis - IEA

Due to the potential for significant damage and disruption to the Project (as outlined above), the inherent risk materiality rating assigned to the construction/start-up phase, beginning of the operational phase, and end of the operational phase is ‘Likely Material – Moderate to High’.

EW3 – Extreme wind impacts on electricity supply (including the Solar Plant)

Extreme winds have the potential to cause direct damage and disruption to the above ground infrastructure associated with the electrical transmission lines (e.g. substations and power lines). The electrical transmission line associated with the Project will connect to an existing substation operated by the Oman Electrical Transmission Company (OETC) within the Sohar Port (which will be the only substation in operation during the construction phase). As a result, if damage was incurred to the OETC-operated substation (due to extreme winds), this would not be the responsibility of the Client to repair (reducing the potential CapEx cost associated with this risk).

However, if damaged substations, or downed power lines result in an interruption of the electricity supply, the Project may be required to source energy from the backup national grid (instead of the proposed Solar Plant which is anticipated to supply 100% of electricity to the LNG plant) – which could require additional OpEx to run. Similarly, disruptions to electricity supply could result in construction delays and/or delays in LNG plant processes which could have a negative impact on supply to LNG customers, reducing Project revenues.

The Solar Plant associated with the Project will provide electricity to the grid, and the LNG plant will consume energy from the grid. If damage to the Solar Plant from extreme winds prevented electricity generation, while this would not disrupt operations (as electricity would still be supplied by the grid itself), this could cause significant reputational impacts for TotalEnergies if the Project’s Scope 2 emissions are not covered by matching IRECs because the plant is not operational. As a result of the potential increases in OpEx and reductions in revenue associated with the construction phase, the inherent risk materiality rating of ‘Likely Material – Low’ has been assigned to the construction/start-up phase of the Project. This inherent risk materiality rating is anticipated to increase to ‘Likely Material – Moderate to High’ by the beginning and end of the operational phases, as damage to substations/powerlines could disrupt the Project’s electricity supply and there is potential for significant reputational impacts associated with the Solar Plant and its impact on GHG emissions.

EW4 & EW5 – Extreme wind impacts on the LNG plant and jetty (CapEx)

Under baseline conditions and future projections, maximum windspeeds are classified within the bounds of a category 1 cyclone, and therefore are likely to only produce a low-moderate amount of damage (compared to higher category cyclones). This is more likely to impact the construction phase of the Project when the LNG plant and jetty infrastructure may not be fully constructed and may be more vulnerable to storm damage. As a result, the construction/start-up phase of the Project is assigned an inherent risk materiality rating of ‘Likely Material – Low’.

Although during the operational phase of the Project, infrastructure and machinery/equipment may be damaged by high winds associated with cyclones (requiring additional CapEx for repairs), the damage and disruption caused during this phase is not anticipated to be as extensive/material as the construction phase of the Project. As a result, the inherent risk materiality rating assigned to beginning of the operational phase, and end of operational phase is ‘Unlikely Material’.

EW6 & EW7 – Extreme wind impacts on access routes and site personnel

Extreme wind events have the potential to pose health and safety risks to site personnel. Extreme winds could increase the movement of debris, increasing the risk of injury to site personnel. Additionally, if outdoor work cannot be undertaken, or if workers are unable to reach the site due to unsafe commuting conditions and/or blocked access routes, this may cause a reduction in operational efficiency, and therefore revenue associated with the Project. However, given that the terrain around the port is largely desert, the opportunity for debris from trees for example, to cause injury/block access routes is deemed less likely. Instead, suspended particles associated with sand/dust storms may cause uncomfortable working conditions for site personnel, particularly those vulnerable to allergic reactions/asthma.

However, risks to staff health and safety associated with this hazard are understood as relatively easy to mitigate (e.g. ensuring staff do not attend work during a cyclone or sandstorm event//ensuring that staff remain indoors during cyclone or sandstorm events).

Taking into consideration the surrounding Project terrain (and therefore potential damage implications), and a relatively low current and projected maximum sustained windspeed, the inherent risk materiality rating assigned to the construction/start-up phase, beginning of the operational phase, and end of the operational phase is 'Unlikely Material'.

It is noted that prior to operations starting, contractors are required to submit Health, Safety and Environmental (HSE) plans regarding specific risks associated with the Project (which are subject to TotalEnergies' approval) – these documents will have to include the specific consideration of climate hazards (e.g. extreme winds). However, this management measure is not already developed and therefore not considered as influencing the assigned inherent risk materiality ratings.

Recommended next steps:

Based upon these risks potential to cause material impacts to the Project, it is recommended that the Client undertakes a more detailed assessment of extreme winds in relation to the Project (and its associated assets and operations). It should also be noted that the implementation of mitigation measures/management plans could potentially reduce the materiality of these risks in relation to the Project. Therefore, it has been identified that there is potential value in the Client assessing/ managing each of these risks further. Below are a series of examples of how this could be achieved:

- **EW1** - **EW6 –** Undertake a further assessment of the potential impacts associated with extreme winds that may emerge in the future and influence the Project's design, for example through undertaking a hazard/storm risk assessment.
- **EW7 -** Consider if there is available shelter for site personnel to access should high winds occur whilst on-site (during the construction and operational phases of the Project) to reduce risks to staff health and safety.
- It is also recommended that all risks (as listed above) are reviewed in further detail within follow-on phases of assessment, with particular consideration being given to the most material risks identified within this assessment - **EW1** & **EW2**.

3.2.4 Wildfires

Trends analysis:

Baseline and projected climate data for wildfires are summarised in Table 3-7 Baseline and projected wildfires climate data, and described below.

Projections indicate an increase in the annual number of days where the climatic conditions could be conducive to wildfires (Forest Fire Danger Index – FFDI), from a baseline of 211 days (approximately 58% of the year) by:

- +5 days to +17 days by 2030, and
- +6 days to +14 days by 2050,

for a lower and higher emissions scenario respectively.

As indicated above, increases for both time horizons under a higher emissions scenario are more significant.

Baseline maximum burned area data offers information on the annual maximum area within a 30km^2 proximity that has been observed (via satellite imagery) to be burnt by any fire between 1989-2018. Within the Project area, the maximum burned area is 1.6km^2 under baseline conditions, which is relatively limited given the timeframe of data. Notably, the region surrounding the Project area is partially desert, which may contribute to a potential reduction in the level of risk posed by wildfires to the Project.

However, as FFDI values are high (and projected to increase in the future) and there is some evidence for historic wildfire activity in the region (e.g., 100 hectares burned in Sohar in 2007, and 7 fire alerts between October 2022 – 2023)[10] it is anticipated that wildfires could pose a potentially material risk to the Project (particularly given the nature of the Project, as the risk of human-induced fires could become artificially increased).

Table 3-7 Baseline and projected wildfires climate data

Variable	Baseline	Projections			
		2030		2050	
		Lower emissions	Higher emissions	Lower emissions	Higher emissions
Forest Fire Danger Index (FFDI) (days)	211	216	228	217	225
Maximum Burned Area (km^2)	1.6	N/A	N/A	N/A	N/A

Risk review:

The below risk review outlines potential risks posed to the Project by wildfires. As summarised in Table 3-8 Wildfire inherent risk materiality ratings, each risk which has been identified has been assigned a risk area, impact category and an inherent risk materiality rating for:

- the construction/start-up phase;
- the beginning of operational phase; and
- the end of operational phase of the Project.

Similarly, a series of recommended steps have also been provided for each risk for review within follow-on phases of assessment.

Table 3-8 Wildfire inherent risk materiality ratings

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction /Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
WF1	LNG Plant	Revenue	Likely Material - Low	Likely Material - Low	Likely Material - Low	No
WF2	LNG Plant	CapEx	Likely Material - Low	Likely Material - Low	Likely Material - Low	No
WF3	Access Routes	Revenue	Likely Material - Low	Likely Material - Low	Likely Material - Low	No

10 Sohar, Al Batinah North, Oman Deforestation Rates & Statistics | GFW (globalforestwatch.org)

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction /Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
WF4	Site Personnel	Revenue	Likely Material - Low	Likely Material - Low	Likely Material - Low	No
WF5	Electricity Supply (including the Solar Plant)	OpEx Reputational	Unlikely Material	Likely Material - Low	Likely Material - Low	No
WF6	Jetty	OpEx	Unlikely Material	Likely Material – Low to Moderate	Likely Material – Low to Moderate	No
WF7	Jetty	CapEx Local communities/ environment Reputational	Unlikely Material	Likely Material – Low	Likely Material – Low	No

Description of potential impacts:

WF1 & WF2 – Wildfire impacts on the LNG plant

Wildfires can cause direct damage to infrastructure and equipment through the impact of heat, flames, and smoke. In severe cases, the risk of fires or explosions within the site could rise as a result of wildfires, which could cause significant damage to infrastructure and equipment. This in turn could require an increase in CapEx if repairs are required, and cause an increase in LNG plant downtime whilst repairs take place – which could lead to business interruption and reductions in revenue generation.

It should also be noted that due to the operations of the Project, the risk of wildfire incidence and spread is artificially increased. For example, LNG can ignite under certain circumstances (e.g., when the concentration of gas is between 5% and 15%[11]). When conditions permit the liquid to warm above -162°C, LNG can revert back to its natural gaseous state, and create potential safety concerns including pool fires and vapor cloud fires. If LNG is spilled near an ignition source (e.g. heat, electricity, flames), the potential exists for the vaporising gas to ignite and burn above the LNG pool. If the LNG pool is not confined, fires could spread quickly – especially over water. This could result in a pool fire expanding over a large area which could result in significant direct damages to the LNG plant.

Based upon the analysis above - the construction/start-up phase, beginning of operational phase, and the end of the operational phase have all been assigned an inherent risk materiality rating of 'Likely Material – Low'. Given the terrain surrounding the Project area and the specific conditions required for LNG to turn to a gaseous state, combined with the requirement for heat, electricity or flames needing to be present to be conducive for an LNG pool fire, this further justifies the inherent risk materiality rating of 'Likely Material – Low' for the beginning, and end of the operational phase.

[11] LNG safety · Energy KnowledgeBase

WF3 & WF4 – Wildfire impacts on access routes and site personnel

Direct heat, flames, dust and smoke (including smoke produced by wildfires which do not directly intersect the Project area) associated with wildfires have the potential to pose health and safety risks to site personnel working on site (e.g. through smoke inhalation) during the construction and operational phases of the Project.

Direct heat and flames associated with wildfires (including wildfires which do not directly intersect the Project area) also have the potential to cause physical damage to road surfaces, including melting and deformation of road surfaces from extreme temperatures, which could result in the obstruction of access routes used by site personnel and to transport construction materials/equipment, causing supply chain disruptions. These impacts have the potential to reduce the productivity of site personnel, particularly if it is not safe for site personnel to remain on site, which could cause delays to the Project completion date, and therefore its production capacity, reducing revenues.

Taking into consideration the potential impacts to site personnel and access routes, the previously assessed climate data and the terrain of the region directly surrounding the Project area, the construction/start-up phase, beginning and end of the operational phase are assigned an inherent risk materiality rating of 'Likely Material – Low'.

It is noted that prior to operations starting, contractors are required to submit Health, Safety and Environmental (HSE) plans regarding specific risks associated with the Project (which are subject to TotalEnergies' approval) – these documents will have to include the specific consideration of climate hazards (e.g. wildfires). However, this management measure is not already developed and therefore not considered as influencing the assigned inherent risk materiality ratings.

WF5 – Wildfire impacts on electricity supply (including the Solar Plant)

Above ground infrastructure such as substations may be subject to physical damage from wildfires. Impacts to the structural integrity of substation infrastructure and equipment components such as transformers and switchgear, could disrupt electricity supply. However, it should be noted that the electrical transmission line associated with the Project will connect to two substations, one of which is an existing substation operated by the Oman Electrical Transmission Company (OETC) within the Sohar Port (which will be the only substation in operation during the construction phase). As a result, if damage was incurred to the OETC-operated substation as a result of wildfires, this would not be the responsibility of the Client to repair (reducing the potential CapEx cost associated with this risk).

However, if damages to the Solar Plant occurred from direct heat and flames, and the supply of electricity from the Solar Plant was disrupted, the Project may be subject to significant reputational impacts if the Project's Scope 2 emissions are not covered by matching IRECs because the plant is not operational.

As a result of OETCs responsibility of the substation to be used during the construction phase (and as the Solar Plant will not be built yet), an inherent risk materiality rating of 'Unlikely Material' has been assigned to the construction/start-up phase. This inherent risk materiality rating is anticipated to increase to 'Likely Material – Low' by the beginning and end of the operational phase, as the second substation and Solar Plant will have been constructed, and there is potential for significant reputational impacts associated with the Solar Plant and its impact on GHG emissions.

WF6 & WF7 – Wildfire impacts on the jetty

Given that the location of the jetty is offshore, it is not anticipated that wildfires will cause significant direct damages to the infrastructure associated with the topside elements of the jetty (e.g., pipe rack, LNG loading arms, and jetty control station). However, dust and smoke associated with wildfires (including wildfires which do not directly intersect the Project area) may increase the requirement for cleaning, and debris clear up which could increase OpEx associated with the Project. Wildfires may also cause direct damage to the electricity supply to the jetty (e.g., substations), cutting off the power supply to the jetty and impacting operations associated with the jetty control station (in previous years wildfires caused power disruption to one of Elengy's LNG plants[12]). CapEx associated with repairs to substations to ensure that usual Project activities can resume, could therefore increase.

In some circumstances, there is potential for wildfires/fires to cause more severe infrastructure damage, that could also increase CapEx associated with the Project. LNG can ignite under certain circumstances (e.g., when the concentration of gas is between 5% and 15%[13]). When conditions permit the liquid to warm above -162°C, LNG can revert back to its natural gaseous state, and create potential safety concerns including pool fires and vapor cloud fires. If LNG is spilled near an ignition source (e.g. heat, electricity, flames), the potential exists for the vaporising gas to ignite and burn above the LNG pool. If the LNG pool is not confined, fires could spread quickly – especially over water. This could result in a pool fire expanding over a large area which could result in significant direct damages to the jetty, negative environmental consequences (e.g. posing a threat to marine biodiversity), and negative reputational risks if smoke/ash from the fire reaches surrounding communities.

As LNG will not be present at the jetty during the construction phase, an inherent risk materiality rating of 'Unlikely Material' has been assigned to the construction/start-up phase. The inherent risk materiality rating increases to 'Likely Material – Low' for the beginning and end of the operational phase, given the specific conditions required for LNG to turn to a gaseous state, combined with the requirement for heat, electricity or flames needing to be present to be conducive for an LNG pool fire and the terrain surrounding the Project area.

Recommended next steps:

Based upon these risks potential to cause material impacts to the Project, it is recommended that the Client undertakes a more detailed assessment of wildfires in relation to the Project (and its associated assets and operations). It should also be noted that the implementation of mitigation measures/management plans could potentially reduce the materiality of these risks in relation to the Project. Therefore, it has been identified that there is potential value in the Client assessing/ managing each of these risks further. Below are a series of examples of how this could be achieved:

- **WS1 – WF7:** Completion of a wildfire risk assessment (this could include the review of: nearby land cover, the presence of relevant and susceptible ground materials/wildfire fuel and the potential for wildfire activity in close proximity to the Project). This could also include a more detailed assessment of historical and future projected changes in wildfire risks.
- The Client could also undertake an assessment of different wildfire prevention systems which could be implemented to reduce the Project's exposure to wildfires (e.g. wildfire breaks and wildfire suppression systems). This recommendation is viewed as particularly relevant for **WF1** & **WF2**.

3.2.5 Water stress and drought

Trends analysis:

Baseline and projected climate data for water stress and drought are summarised in Table 3-9 Baseline and projected water stress and drought climate data, and described below.

The World Resources Institute (WRI) water stress indicator measures the ratio of total water withdrawals to available renewable surface and groundwater supplies.

According to climate projections for the Project area, the WRI water stress category is projected to increase from a 'High' baseline result to:

- 'Extremely High' by 2030; and
- 'Extremely High' by 2050

  for both a lower and higher emissions scenario.

[12] Elengy says its two LNG terminals back online after fire at Fos-sur-Mer - Offshore Energy (offshore-energy.biz)

[13] LNG safety · Energy KnowledgeBase

Considering the 'High' baseline level of water stress, and the projected increase to an 'Extremely high' level under each scenario and timeframe, based on the climate data, it is anticipated that water stress and drought has the potential to cause material risks to the Project.

As previously outlined, it is known that Oman has a subtropical, dry climate, and even during the rainy period (February to March), there is only an average monthly rainfall of 13mm. May to October are the driest months with average monthly rainfall as low as between 1.5 and 2.2 mm. With increases in water stress projected, and an already very low average monthly rainfall, this information provides further support for the potential for water stress and drought to impact the Project area.

Table 3-9 Baseline and projected water stress and drought climate data

Variable	Baseline	Projections			
		2030		2050	
		Lower emissions	Higher emissions	Lower emissions	Higher emissions
Water stress	High (40-80%)	Extremely High (>80%)	Extremely High (>80%)	Extremely High (>80%)	Extremely High (>80%)

Risk review:

The below risk review outlines potential risks posed to the Project by water stress and drought. As summarised in Table 3-10 Water stress and drought inherent risk materiality ratings, each risk which has been identified has been assigned a risk area, impact category and an inherent risk materiality rating for:

- the construction/start-up phase;
- the beginning of operational phase; and
- the end of operational phase of the Project.

Similarly, a series of recommended steps have also been provided for each risk for review within follow-on phases of assessment.

Table 3-10 Water stress and drought inherent risk materiality ratings

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction /Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
WSD1	Site Personnel	OpEx Revenue	Likely Material - Low	Likely Material - Low	Likely Material - Low	No
WSD2	Water Supply	OpEx	Likely Material - Low	Likely Material - Low	Likely Material - Low	No

Risk ID	Risk area	Impact category	Inherent Risk Materiality Rating			Recommended as a particular focus for further assessment
			Construction /Start-up phase (baseline)	Beginning of operational phase (2030)	End of operational phase (2050)	
WSD3	Pipelines & Electricity Supply	Revenue	Likely Material - Low	Likely Material - Low	Likely Material - Low	No

WSD1 – Water stress and drought impacts on site personnel

Water stress and drought has the potential to pose a range of health and safety risks to site personnel if the availability of clean and safe water is limited (e.g., dehydration, heat exhaustion, and heat stroke etc.). Although the data indicates an already 'High' baseline level of water stress which increases to 'Extremely High' by 2030, as the Majis water plant will supply potable water to the Project (seawater that will undergo a desalination process), reduced water availability throughout the construction and operational phases of the Project is limited, as well as the potential health and safety risks to site personnel.

However, if the Majis water plant desalination process failed, alternative (less local) water suppliers may need to be sourced, which could increase OpEx. Similarly, if an alternative water supply can not be sourced in a timely manner due to reduced water availability as a result of water stress and drought, the aforementioned health and safety risks posed to site personnel, could become more material. This could also cause hygiene and sanitation practices to be compromised due to a reduction in access to clean freshwater (e.g., reduced hand washing and cleaning of on-site portable toilets) which could result in an increase in disease transmission. As a result, productivity (and therefore revenues) could be reduced as increased breaks may be required, or, in a worst-case scenario, work may be unable to continue as workers do not have access to clean freshwater.

.Based on this analysis, an inherent risk materiality rating assigned to the construction/start-up phase, the beginning of the operational phase, and the end of the operational phase is 'Likely Material – Low'.

It is noted that prior to operations starting, contractors are required to submit Health, Safety and Environmental (HSE) plans regarding specific risks associated with the Project (which are subject to TotalEnergies' approval) – these documents will have to include the specific consideration of climate hazards (e.g. water stress and drought). However, this management measure is not already developed and therefore not considered as influencing the assigned inherent risk materiality ratings.

WSD2 – Water stress and drought impacts on water supply

The construction and start of the operational phase (commissioning) of an LNG plant involves water-intensive processes, with water being required for various aspects, including construction works, dust suppression, hydrotesting and personnel use. Hydrotesting, for example, requires freshwater for cleaning of the LNG tank (90,000 m^3 of seawater and freshwater combined), and to check for leaks within any piping that has been installed (6,000m^3). Although seawater can be used during hydrotesting of the LNG tank, due to the potentially corrosive nature of seawater to the installed infrastructure, it is necessary that the LNG tank is cleaned afterwards with freshwater. Although the data indicates an already 'High' baseline level of water stress which increases to 'Extremely High' by 2030, seawater will be supplied by the Majis water plant, and to supply potable water, seawater will undergo a desalination process, meaning reduced water availability throughout the construction phase of the Project is limited. If the Majis water plant desalination process failed, alternative (less local) water suppliers may need to be sourced, which could increase OpEx. Therefore, an inherent risk materiality rating assigned to the construction/start-up phase is ‘Likely Material – Low’.

Similarly, during the operational phase of the Project, the Majis water plant will supply process and potable water (as the seawater will undergo a desalination process), meaning reduced water availability throughout the operational phase will also be limited (although there is some risk of an increase in OpEx should the Majis water plant desalination fail). An inherent risk materiality rating of ‘Likely Material – Low’ has therefore also been assigned to the beginning of the operational phase, and end of the operational phase of the Project.

WSD3 – Water stress and drought impacts on pipelines and electricity supply (including the Solar Plant)

Pipelines such as the OQGN feed gas pipeline and parts of the condensate export pipeline, and electrical transmission lines for the Project are located underground. Dry spells can cause the drying and shrinking of the ground which supports pipeline and transmission line infrastructure. The shrinking of the ground can exert tensile forces onto pipelines and transmission lines, particularly to more vulnerable joints and connection points, potentially causing fractures. This could lead to downtime whilst maintenance, repair or replacement of damaged pipelines and transmission lines takes place.

Above ground infrastructure associated with electricity transmission lines such as substations may also be subject to the impacts of water stress and drought. Dry spells may lead to the ground becoming dry as the moisture in the soil reduces in content, and therefore reduces soil resistivity, impacting network earthing systems. Ground instability may be caused by shrinking of the ground, making the substations subject to movement, or in severe cases, its collapse and damage. These impacts can cause a loss in revenue due to a reduced energy supply to allow construction activities to take place, and a reduced energy supply available to consumers during the operational phase.

Energy supply from the proposed Solar Plant could also be reduced if water stress and drought limits the availability of water for cleaning. However, research suggests that, solar panels should be cleaned at least once a year, so it is unlikely that water stress and drought would have severe implications on the cleaning regime, and therefore Solar Plant electricity supply production.

The impact of water stress and drought on pipelines and electricity supply is therefore anticipated to be prevalent throughout the duration of the Project. Therefore, the inherent risk materiality rating assigned to the construction/start-up phase, beginning of the operational phase, and the end of the operational phase is ‘Likely Material – Low’.

Recommended next steps:

Based upon these risks potential to cause material impacts to the Project, it is recommended that the Client undertakes a more detailed assessment of water stress and drought in relation to the Project (and its associated assets and operations). It should also be noted that the implementation of mitigation measures/management plans could potentially reduce the materiality of these risks in relation to the Project. Therefore, it has been identified that there is potential value in the Client assessing/ managing each of these risks further. Below are a series of examples of how this could be achieved:

- **WSD1 –** Ensure the HSE plans submitted by contractors are sufficient to protect the health and safety of site personnel during periods of water stress and drought.
- **WSD2 –**. Consider alternative potable water sources to ensure that a potable water supply is maintained throughout the Project (e.g., in the event of a Majis water plant desalination failure).
- **WSD3 –** Investigate how water stress and drought could impact the land surrounding the LNG plant. The findings of the investigation could be used to inform the Project’s design.
- It is also recommended that all risks (as listed above) are reviewed in further detail within follow-on phases of assessment.

3.3 Hazards excluded from risk review

This section includes all climate hazards which are not anticipated to cause materials risk in relation to the Project (based on analysis of the climate trends associated with each hazard).

Below is a summary of the climate hazards which have been excluded from the risk review step of this assessment, together with the rationale for this:

Table 3-11 Table showing the rationale for hazard exclusion from risk review

Climate Hazard	Rationale for exclusion
Extreme Cold	▪ For extreme cold, minimum daily temperatures have been collected at the location of the LNG plant associated with the Project. Under baseline conditions, minimum daily temperatures are recorded at +9.4°C. As a result, under baseline conditions extreme cold is not anticipated to be likely to pose a material risk to the Project. ▪ Future projections (across all future scenarios/timeframes) indicate an increase in minimum daily temperatures, representing a decrease in an already low baseline level of risk posed by extreme cold. ▪ Therefore extreme cold is not anticipated to be likely to pose a material risk to the Project under any time horizon associated with the Project.
Landslides	▪ For both baseline and future projections, the risk of rainfall-induced landslides is minimal and unlikely to be material based on the Rainfall-Induced Landslides Index. Data. ▪ It is anticipated that the LNG plant will be built on terrain with an elevation of 0m. As a result, the risk from landslide activity is not anticipated to be significant.

4. SUMMARY AND CONCLUSION

There are a range of climate hazards which have been identified as present within the Project area – each of which posing a wide-range of risks to the Project and its operations. Each of these risks have been assigned inherent risk materiality ratings (representing the innate level of risk posed to the Project in the absence of further management/mitigation) – ranging from 'Unlikely Material' to 'Likely Material – Moderate to High'. For each of the assessed risks, a series of high-level examples of next steps which could be taken by the client to further manage/assess each risk have also been provided.

The most significant inherent risks (e.g. those which have been categorised as 'Likely Material – Moderate to High') identified within this report are associated with: extreme heat, coastal/extreme rainfall flooding, and extreme winds, and include:

- **Extreme heat impacts on site personnel**
- **Extreme heat impacts on the LNG plant**
- **Extreme heat impacts on pipelines**
- **Flooding impacts on the LNG plant**
- **Coastal flooding impacts on the jetty**
- **Flooding impacts on site personnel**
- **Flooding impacts on the electricity supply (including the Solar Plant)**
- **Extreme wind impacts on the LNG plant**
- **Extreme wind impacts on the jetty**
- **Extreme wind impacts on the electricity supply (including the Solar Plant)**

It is recommended that all risks (including the additional lower materiality risks which are also included in Section 3.2) identified within this report are reviewed in further detail within follow-on phases of assessment with particular consideration being given to the most material risks – as listed above.

Further assessment associated with Phase 2 of this CCRA is anticipated to include:

- An initial re-review of all risks identified within this report, against any updates which have been made to the Project's design to manage/mitigate each risk (including an assessment of each risks residual risk level) - to assess whether risks are still considered potentially material. This could also include the review of TotalEnergies' Climate Change Physical Risk design study (including this study's methodology, findings and recommendations for the Project's design).
- The financial quantification of any residual risks which are still considered potentially material.
- Collaboration with the Client to ensure that estimations of the financial impact of each risk are representative.

Once risks have been quantified, the Client will have the opportunity to implement further management/mitigation measures into the Projects design to further manage material risks. Following this, to fully align with the EP4's 2023 guidance, the Client will be required to document the risks which have been identified as potentially material to the Project and; how these risks are being managed/mitigated within a Climate Change Risk Management Plan (CCRMP).

5. ANNEXES

ANNEX 1 PROPOSED PROJECT SITE MAP

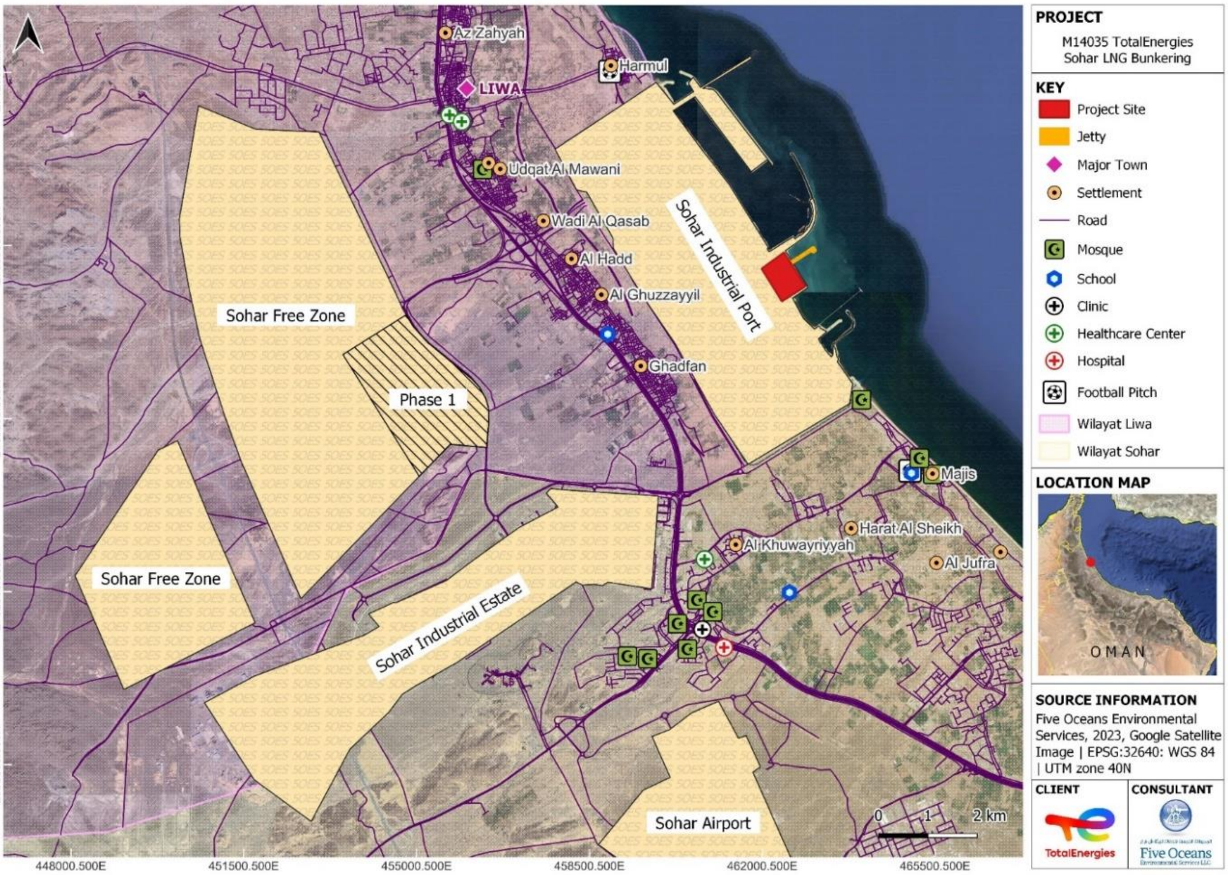

Figure 5-1 Map of the Project location

ANNEX 2 DETAILED OVERVIEW OF CLIMATE DATA, SCENARIOS AND TIME HORIZONS

Baseline and projections data

The baseline and projections climate data used in this assessment is compiled from numerous international scientific organizations, including:

- Intergovernmental Panel for Climate Change (IPCC)
- World Resource Institute (WRI)
- International Best Track Archive for Climate Stewardship (IBTrACS)
- National Aeronautics and Space Administration (NASA)
- European Space Agency (ESA), Fathom (for flooding)
- World Bank

The climate data used in this assessment is comprised of a variety of types of climate data, as outlined in the table below:

Data Type	Definition
Observational data (baseline only)	Is based upon observations recorded and collected at various weather stations located around the world.
Reanalysis data (baseline only)	Describes the reanalysis of previously recorded climate data, either from observational or modelled records. This source of data aims to correct any biases, errors and aspects of physical climatic processes that were previously unidentified within older iterations of data. These corrections can be carried out via the back testing of data against newly observed climatic trends and/or modelled climate data[14].
Modelled data	Aims to identify, quantify and accurately represent complex physical processes within the climate and can be generated in a variety of formats, depending on the physical process being modelled, based on models of differing resolution (e.g. Global Climate Models or Regional Climate Models). Modelled climate data can be used to highlight trends in climatic processes under historic (past), present and projected future climatic conditions[15].

Climate Scenarios

The IPCC is the UN's leading body for assessing the science related to climate change. The IPCC provides periodic Assessment Reports (AR) reviewing the available literature on climate change as well as trends in climatic hazards. With each new AR comes a new round of climate models and data which is developed by the IPCC and Coupled Model Intercomparison Project (CMIP). The newest round of climate data from the IPCCs AR6, published in 2021, is utilised and marks the most well-rounded set of published climate data (as provided in CMIP6).

The data provided by CMIP6 is seen to improve upon the data provided by CMIP5 by using a greater number of climate model runs and modelling groups. CMIP6 also sees a move away from Representative Concentration Pathways (RCPs) to Shared Socio-economic Pathways (SSPs), which aim to bridge the gaps between the physical climate and social sciences, and to explore the potential future climate response to a broader range of greenhouse gases (GHG), land uses and air pollutants, in comparison to AR5.

[14] ECMWF (2021), Climate Reanalysis. Available at: https://www.ecmwf.int/en/research/climate-reanalysis
[15] NOAA (2021), Climate Models. Available at: https://www.climate.gov/maps-data/primer/climate-models

Each of the SSPs set out by the IPCC represent scenarios that vary on the basis of future projected greenhouse gas emissions and resultant warming over the next century. As GHG's increase, there is the potential that climatic conditions within any given area could also change (e.g. increasing temperatures and/or changes to precipitation regimes). However, the specific changes experienced for any given area can vary, depending on prescribed increase in GHG emissions associated with each SSP and time horizon.

Scenarios are selected based on their appropriateness for any given assessment being undertaken. The technical guidance on physical scenario analysis from the TCFD and other sources advise the inclusion of a selection of scenarios covering a variety of reasonable outcomes. This includes the inclusion of a scenario representative of keeping global average temperatures at 2ºC or lower, most closely aligned with the Paris Agreement[16]. As a result, the inclusion of two SSPs: SSP1-2.6 and SSP5-8.5 has been selected (see below table for estimated temperature increases and definitions associated with each SSP):

Scenario	Definition	Mean annual temperature increase by 2100 compared to pre-industrial averages (1850)
SSP1-2.6	A low emissions scenario that stays below 2°C warming by 2100, aligned to the current commitments under the Paris Agreement.	**+1.8ºC** (very likely range of 1.0ºC to 1.8ºC)
SSP5-8.5	A high emissions scenario which follows a 'business as usual' trajectory, assuming no additional climate policy and seeing CO_2 emissions triple by 2100.	**+4.4ºC** (very likely range of 3.3ºC to 5.7ºC)

Time Horizons

This CCRA includes the assessment of physical climate hazards under baseline and future projected conditions. Data collected related to the baseline time period will be used to assess the potential physical climatic hazards that are currently present within the specified Project area. Whereas data for future projected time periods will be used to assess the potential change in the risk associated with these hazards – in relation to the Project and its lifetime. Justification for the time horizons selected for inclusion are outlined in the below table.

Time horizon	Justification
Baseline (present-day)	The construction phase of the Project will take approximately 34 months to complete, including pre-commissioning and commissioning phases. Currently, it is foreseen that the main construction activities will start in the third quarter of 2024 and will be concluded with the start-up of the plant in mid-2027. The onshore plant should treat quality gas to produce LNG, primarily dedicated to LNG bunkering activities but also to carriers loading at the Sohar Port in Oman. The commissioning phase will last 15 months and will start by the first quarter of 2026. This time horizon will be used to assess climatic hazards and risks that could potentially be present during the construction phase, and early operational phase of the

[16] TCFD (2017), Recommendations of the Task Force on Climate-related Financial Disclosures. Available at: https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf

Time horizon	Justification
	Project (baseline data will be used in tandem with projections data during the operational phase).
2030	Given the expected operational lifetime (25 years) of the LNG plant associated with the Project, future time horizons (2030 and 2050) have been selected for inclusion within this assessment to reflect this lifetime. These time-horizons will be used to identify the level of risk which the Project could be exposed to during the start-middle (2030) and end (2050) of the Projects expected operational lifetime (~2050).
2050	

ANNEX 3 DEFINITIONS OF ALL CLIMATE HAZARDS INCLUDED WITHIN THIS ASSESSMENT

Climate Hazard	Definition	Climate Indicator Used to Represent that Climate Hazard
Extreme Heat	Extreme heat is defined as a period of time when temperatures are much hotter and/or more humid than long-term averages. Because some places are hotter than others, this depends on what's considered average for a particular location at that time of year (WMO, 2021).	**Warm Spell Duration Index (WSDI)**: ***Baseline & Projections:*** The annual number of days contributing to unusually warm events where six or more consecutive days experience a maximum temperature (TX) of greater than the 90th percentile of the historical averages for that time of year. - ***Baseline period***: 1985-2014 - ***Unit:*** Days
Extreme Cold	Extreme cold is defined as a period of time when temperatures are much colder than long-term averages. Because some places are colder than others, this depends on what's considered average for a particular location at that time of year (WMO, 2021).	**Cold Spell Duration Index (CSDI):** ***Baseline & Projections:*** The annual number of days contributing to unusually cold events where six or more consecutive days experience a minimum temperature (TN) of less than the 10th percentile of the historical averages for that time of year. - ***Baseline period***: 1985-2014 - ***Unit:*** Days
Riverine Flooding	Riverine flooding can occur over a wide range of river and catchment systems. Floods in river valleys occur mostly on flood plains or wash lands as a result of flow exceeding the capacity of the stream channels and spilling over the natural banks or artificial embankments (WMO, 2011). High levels of rainfall and increased flow velocity often contribute to river flooding events.	**Riverine flooding inundation depth:** ***Baseline & Projections:*** Baseline & Projections: The maximum inundation depth experienced within a 270mx270m area that is associated with a 1-in-500-year fluvial (riverine) flooding event. - ***Baseline year***: 2020 - ***Unit:*** Metres
Extreme Rainfall Flooding	Extreme rainfall flooding occurs where high-intensity rainfall exceeds the capacity of the drainage systems. Intense rainfall over the urban area may cause flooding of streets and property in low-lying areas, in old waterways, underpasses and depressions in highways. Often such flooding is exacerbated by debris that clogs inlets to pipes and channels, or outlets of retention basins (WMO, 2011).	**Pluvial flooding inundation depth:** ***Baseline & Projections:*** The maximum inundation depth experienced within a 270mx270m area that is associated with a 1-in-500-year pluvial (extreme-rainfall-induced) flooding event. - ***Baseline period***: 2020 - ***Unit:*** Metres
Coastal Flooding	In coastal areas, storm surges caused by tropical cyclones, tsunamis or rivers swollen by exceptionally high tides can cause coastal flooding. Storm surges and high winds coinciding with high tides are the most frequent cause of this type of flooding. The surge itself is the result of the raising of sea levels due to low atmospheric pressure (WMO, 2011).	**Coastal flooding inundation depth:** ***Baseline:*** The maximum inundation depth associated with a 1-in-500-year coastal flooding event as a result of historical sea level rise, land subsidence, storm surges and/or high tide events. ***Projections:*** The maximum inundation depth associated with a 1-in-500-year coastal flooding event as a result of projected sea level

Climate Hazard	Definition	Climate Indicator Used to Represent that Climate Hazard
		rise, land subsidence, storm surges and/or high tide events. - ***Baseline year:*** 2010 - ***Unit:*** Metres
Tropical Cyclones	The general term for a strong, cyclonic-scale disturbance that originates over tropical oceans. Distinguished from weaker systems by exceeding a threshold wind speed. A tropical storm is a tropical cyclone with one-minute average surface winds between 18 and 32 m s-1. Beyond 32 m s-1, a tropical cyclone is called a hurricane, typhoon or cyclone, depending on geographic location (IPCC, 2018). The Saffir-Simpson Hurricane Wind Scale is a 0 (Tropical Storm) to 5 (High-Intensity Cyclones) categorisation based on the hurricane's intensity. The scale provides examples of the type of damage and impacts in the United States associated with winds of the indicated intensity (NOAA, 2021).	**Maximum tropical cyclone wind speed:** ***Baseline:*** The maximum sustained wind speed associated with being within 200 km of a tropical cyclone event. ***Projections:*** The maximum sustained wind speed associated with being within 200 km of a tropical cyclone, based on cyclone basin-specific tropical cyclone projections generated using AR6 global mean surface temperature projections. - ***Baseline period***: 1980-2022 - ***Unit:*** Knots
Rainfall-Induced Landslides	Landslides are local events and usually unexpected. They occur when earthquake, heavy rain, rapid snow, ice melt or an overflowing crater lake loosens vulnerable parts of the landscape on steep slopes, resulting in large amounts of earth, rock, sand or mud flowing swiftly down slope. Hillsides or mountain sides that are bare or have had their vegetation cover degraded through clearance or by forest or brush fires may be especially at risk. They can reach speeds of over 50 km/h and can bury, crush or carry away people, objects and buildings (WMO, 2021). The Climate Impact Platform focuses on assessing the risk of climate driven landslides, i.e., extreme rainfall.	**Rainfall-Induced Landslide Index (RILI):** ***Baseline & Projections:*** The annual number of days with a potential chance of a rainfall-induced landslide event. This index is developed using antecedent rainfall index (weighted summation of daily rainfall amounts) and landslide susceptibility (based on slope, faults, geology, forest loss, and road networks). - ***Baseline period***: 1985-2014 - ***Unit:*** Number of days with a potential chance of a landslide event
Wildfires	A wildfire is categorized as such by any unplanned and/or uncontrolled vegetation fire, including management-ignited vegetation fires that exceed the restrictions in the fire plan and require suppression actions (UN, 2021).	**Maximum burned area:** ***Baseline:*** The maximum area that has been burned by any fire type within a 30 km^2 area. - ***Baseline period:*** 1989-2018 - ***Unit:*** Square Kilometres (km^2) **Forest Fire Danger Index (FFDI):** ***Baseline & Projections:*** The annual number of days with fire-permitting climatic conditions. This index is based on the McArthur Forest

Climate Hazard	Definition	Climate Indicator Used to Represent that Climate Hazard
		Fire Danger Index (FFDI; widely used in Australia for several decades) and combines a record of dryness, based on rainfall and evaporation, with meteorological variables for wind speed, temperature and humidity. - ***Baseline period:*** 1985-2014 - ***Unit:*** Number of days with fire-permitting climatic conditions
Water Stress & Drought	Water stress is typically defined by water availability and use. Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use (EEA, no date). Drought is a prolonged dry period in the natural climate cycle that can occur anywhere in the world. It is a slow-onset phenomenon caused by a lack of rainfall (WMO, 2021).	**Water Stress:** ***Baseline:*** Water stress measures the ratio of total water withdrawals to available renewable surface and groundwater supplies. Water withdrawals include domestic, industrial, irrigation, and livestock consumptive and non-consumptive uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. ***Projections:*** Projected water stress estimates the future competition for water resources and is defined as the ratio of demand for water by human society divided by available water. - ***Baseline period:*** 1960-2014 - ***Unit:*** Categorical

ANNEX 4 CONSTRUCTION, PRECOMISSIONING AND COMISSIONING PHASE ACTIVITIES ASSOCIATED WITH THE PROJECT

The main impacting Project activities to take into consideration during the construction, precommissioning and commissioning of the entire set of Project facilities and utilities are listed below and described in the following subsections.

- Civil works for construction, including excavation works, terrain levelling and compacting, foundation and basement laying.
- Depending on the quality of the existing reclaimed area, some soil improvement might still be required such as deep soil improvement and/or stone columns. Then, standard pilling and shallow foundations would be installed to support plant infrastructure.
- Temporary Site Facilities Construction of buildings (maintenance building, security huts, offices, etc.).
- Set up and installation of facilities and associated infrastructure.
- Mechanical and electrical works (e.g., tie-in).

The potential impacts of this phase are mainly related to the following activities:

- Earth moving for construction and clearance;
- Movement of vehicles, equipment, personnel and supplies;
- Movement and storage of construction materials;
- Storage and handling of fuels and chemicals;
- Waste management; and
- Presence of workers in the surrounding areas.

The activities will involve mobilisation, site clearance and preparation (infilling), construction of onshore facilities, completion of the jetty, pre-commissioning and commissioning of the LNG Plant.

Disclaimer

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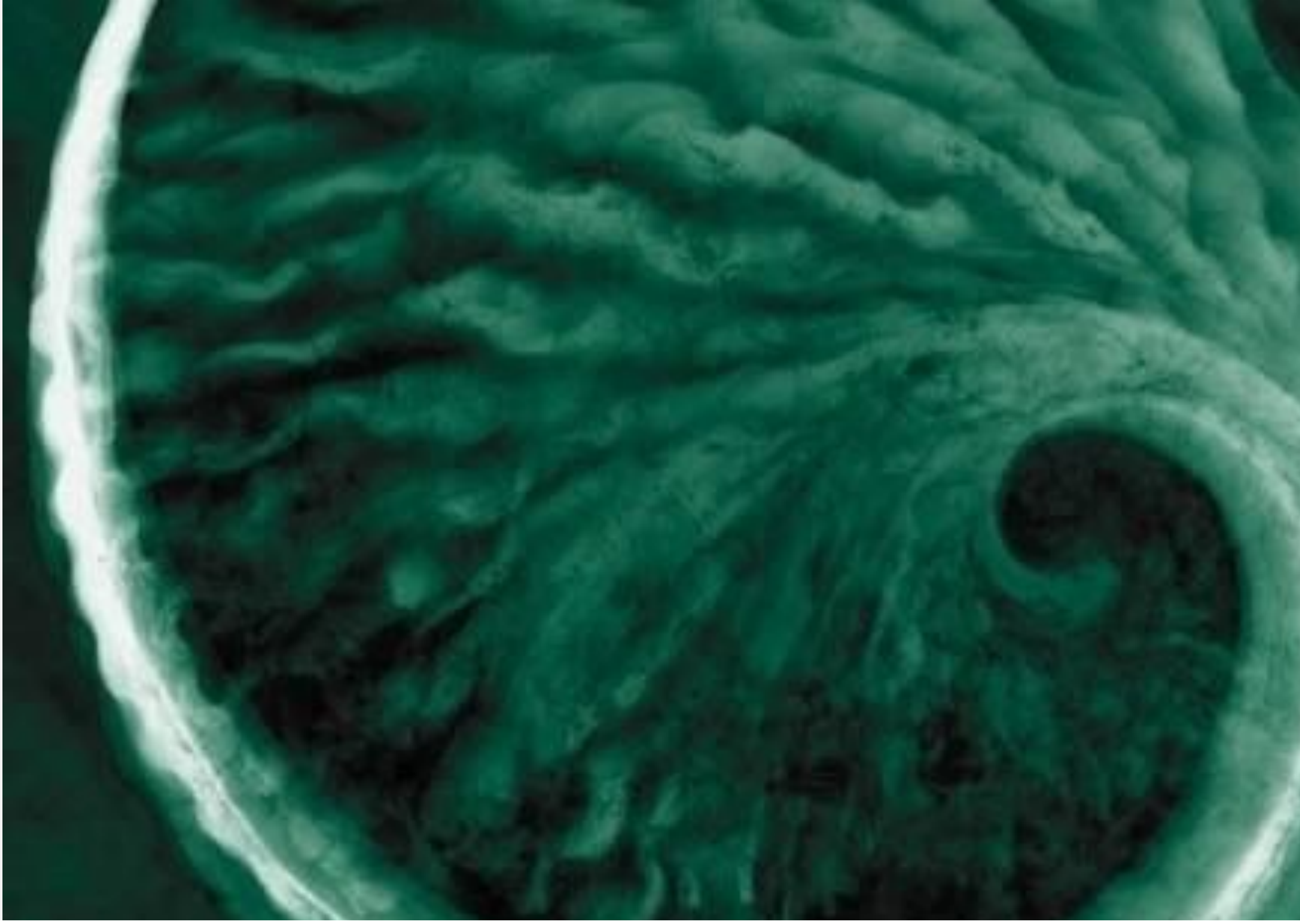
PART 2

GHG EMISSIONS INVENTORY



CCRA Part 2 GHG Emissions Inventory

MARSA LNG Bunkering Project, Sohar, Oman

28 November 2023

Project No.: 0523286

ERM

The business of sustainability

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CONTENTS

CONTENTS II

List of Tables ... ii
List of Figures ... iii
Acronyms and Abbreviations ... iii

1. INTRODUCTION ... 1
1.1 Overview and Project Background ... 1
1.2 Embedded Measures in the Project Design ... 3
1.2.1 Carbon Footprint Reduction Initiatives considered for the LNG Plant ... 3
1.2.2 LNG plant components ... 4
2. RELEVANT DOCUMENTS AND STANDARDS ... 6
2.1 National Standards ... 6
2.2 International Standards ... 7
3. METHODOLOGY ... 8
4. PROJECT GHG EMISSIONS ... 9
4.1 Construction Phase GHG Emissions ... 9
4.1.1 Construction Phase Energy Consumption ... 9
4.1.2 Construction Phase: Scope 1 Emissions ... 9
4.1.3 Construction Phase: Scope 2 Emissions ... 10
4.1.4 Total Emissions During Construction Phase ... 10
4.2 Operational Phase GHG Emissions ... 10
4.2.1 Operational Phase Energy Consumption ... 10
4.2.2 Operational Phase: Scope 1 Emissions ... 12
4.2.3 Operational Phase: Scope 2 Emissions ... 13
4.2.4 Total Emissions During Operational Phase ... 14
4.3 Summary of Construction and Operations Emissions ... 14
4.4 Ozone Depleting Substances ... 15
4.4.1 Application of ODS and Non-ODS ... 15
5. SITUATION OF PROJECT GHG EMISISONS WITHIN NATIONAL AND INTERNATIONAL CONTEXT ... 16
5.1 Introduction ... 16
5.2 Oman' NDCs ... 16
5.3 Comparison to international thresholds ... 16
5.4 Situation of the Project within the NDC and international thresholds ... 16
6. RECOMMENDATIONS ... 17

ANNEX 1 CONVERSION FACTORS
ANNEX 2 GHG INVENTORY CALCULATIONS
ANNEX 3 GHG MITIGATION MEASURES

List of Tables

Table 4.1 Estimated Total Energy Consumption of the Construction Phase ... 9
Table 4.2 Annual Scope 1 Emissions During Construction Phase ... 9
Table 4.3 Emissions During Construction Phase ... 10
Table 4.4 Estimated Annual Energy Consumption During Operation ... 11
Table 4.5 Annual Gaseous Energy Usage During Operational Phase Breakdown ... 11

Table 4.6 Annual Electricity Consumption during Operations 11
Table 4.7 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (Base Case) 12
Table 4.8 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (High CO_2 Case) 12
Table 4.9 Annual Gaseous Sources of Emissions During Operational Phase 13
Table 4.10 Annual Scope 2 Emissions During Operation Phase 14
Table 4.11 Total Emissions During Operational Phase 14
Table 4.12 GHG Emissions for each Project Phase 14
Table 5.1 Magnitude Scale for Project GHG Emissions (per IFC) 16

List of Figures

Figure 1.1 Project Site and Surrounding Infrastructure 1
Figure 1.2 Process Flow Diagram for the Project 3
Figure 2.1 Overview of GHG Emission Scopes 7

Acronyms and Abbreviations

Name	Description
AGRU	Acid Gas Removal Unit
CCRA	Climate Change Risk Assessment
CO_2e	Carbon Dioxide equivalent emissions
EP4	Equator Principles IV
EPC	Engineering Procurement Contractor
GHG	Greenhouse Gas (Emissions)
GHG-A	Greenhouse Gas Assessment
GWP	Global Warming Potential
IFC	International Finance Corporation
kWh	Kilo Watt Hour
LNG	Liquified Natural Gas
NRU	Nitrogen Rejection Unit
ODS	Ozone Depleting Substances

1. INTRODUCTION

1.1 Overview and Project Background

This Greenhouse Gas Assessment study is being submitted in conjunction with the Environmental and Social Impact Assessments (ESIA) for the Liquefied Natural Gas (LNG) Bunkering Project being developed by MARSA LNG LLC. The purpose of this report is to

- To calculate GHG emissions for the construction and operational phases of the Project;
- To contextualise annual emissions against international and national thresholds; and
- To determine whether expected operational GHG emissions are deemed to be 'significant', according to international guidance.

Additionally, the relevant Ozone Depleting Substances (ODS) that will be used during this project are also described.

The LNG Bunkering Project (i.e., the Project) consists of an onshore treatment and liquefaction plant producing Liquefied Natural Gas (LNG) primarily dedicated to LNG bunkering activities, but also to carriers loading at the Sohar Port in Oman. The LNG plant will be built on reclaimed land protected by an embankment and leased from the Sohar Industrial Port Company (SIPC). From a design perspective, the main project concept has been selected and Front-End Engineering Design (FEED) has been undertaken to develop the Project concept. The Project will be located in Sohar Industrial Port, situated approximately 220 km northwest of Oman's capital city, Muscat.

Figure 1.1 Project Site and Surrounding Infrastructure

The Project will consist of the following key elements:

- **LNG Plant:** consisting of a series of equipment and processes through an LNG Train and related auxiliary equipment to clean and treat the incoming gas, and liquefy the purified natural gas to produce LNG.
- **Condensate Export Pipeline**: comprising a short pipeline (<1 km) that will supply condensate (a by-product of the LNG Plant production) to ADVARIO's tank farm (former Oil Taking Terminal (OTT)) for future use by other industry within the Sohar Port (i.e., OQ Refineries and Petroleum Industries LLC - OQRPI). Outside of MARSA LNG LLC's fence, the condensate export pipeline will cross an existing pipeline corridor within the port to reach the tank farm fence which is located approximately 100 m from the fence. Around 10 m of the pipeline may be buried and the rest will be above ground on the existing/upgraded pipe rack. While the pipeline construction, tie-in to ADVARIO's tank farm and commissioning will be completed an EPC Contractor of MARSA LNG, the operation and maintenance of the pipeline will be the responsibility of MARSA LNG.
- **Electrical Transmission Line:** comprising an approximately 3.5 km-long buried electrical cable that will connect the LNG substation with the existing Substation operated by Oman Electricity Transmission Company (OETC) within the Sohar Port. The installation, termination and connection between the two substations will be undertaken by MARSA LNG LLC's EPC Contractor. Operation and maintenance of the LNG substation as well as the underground transmission line will be the responsibility of MARSA LNG.
- **Topside of the LNG Export Jetty**: the jetty subsea foundation and access road will be designed and built by SIPC and is outside the Project's scope. However, the jetty topsides (operational area) will be completed by MARSA LNG LLC's EPC Contractor and is part of the Project' scope. The topside elements required for loading include a pipe rack, process manifolds, LNG loading arms, safety measures, and a jetty control station. The operation of the jetty topsides is within the Project' scope, while the substructure maintenance and mooring operations remain within SIPC's scope of work.
- **Photovoltaic (PV) Plant:** The power will be provided by a future solar PV plant (at a remote location and which will feed the existing grid). This is an associated facility. The LNG plant will be connected to the grid via a buried electrical cable.

The gas will be delivered at the expected average rate of 150 Million Standard Cubic Feet per Day (M) to the Plant inlet. The nominal (i.e., typical) flow rate will be of 158 M considering the LNG Plant availability.

The feed gas will be pre-treated upstream of the LNG plant site and will be delivered to the LNG plant by OQGN's existing pipeline network. Additional pre-treatment will be required at the LNG plant further refining the gas for export. Upon arrival to the inlet facility, the feed gas will be filtered and flow through a mercury-removal unit. Carbon dioxide (CO_2) will be removed by an Acid Gas Removal Unit (AGRU) through an absorption process into an amine-based solvent. The subsequent storage or disposal route for the captured CO_2 is not known to date. Water will be removed to prevent hydrate and ice formation in the cryogenic section using a dehydration unit with regenerative molecular sieve beads.

The LNG produced in the plant will be sent to an onshore storage tank, before being loaded to bunkering vessels or LNG carriers via a dedicated LNG marine terminal (jetty and associated LNG loading system). While the vessel traffic for users is not part of the Project's scope, it is considered as an associated activity for the scope of the ESIA; therefore, the activities associated to marine traffic, vessel movements and operations inside the port area are part of the scope of this ESIA To date, due to lack of information GHG emissions from these activities have not been included in the GHG inventory

All vapours generated during loading system will be returned to the Boil-off Gas Recovery System of the facility, compressed, and send back to the LNG train. The fuel gas will be supplied through a dedicated network and will be used by the AGRU and NRU incinerators and the flare pilot.

A process flow diagram presenting the inputs and outputs of the LNG plant is presented in below:

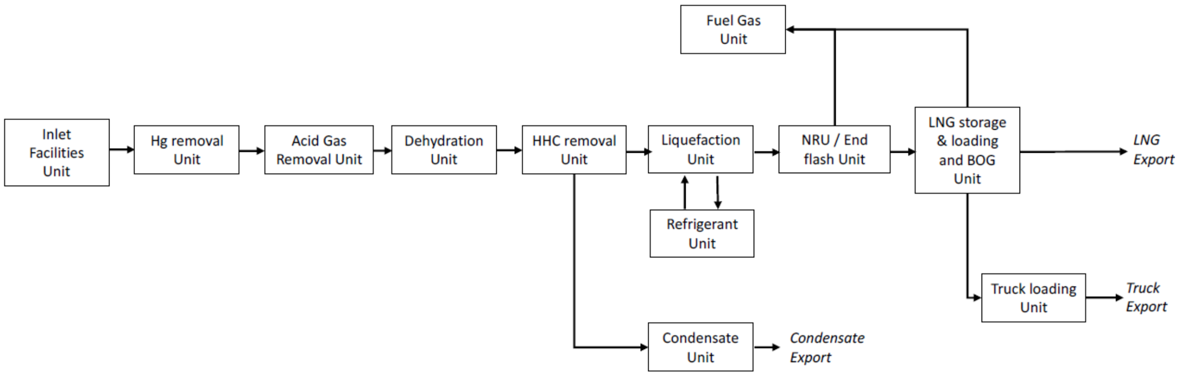


Figure 1.2 Process Flow Diagram for the Project

1.2 Embedded Measures in the Project Design

1.2.1 Carbon Footprint Reduction Initiatives considered for the LNG Plant

To minimize the impact of Project activities, during the FEED Update, a Carbon Footprint Reduction exercise has been carried out to identify GHG reduction initiatives for the Marsa LNG project by MARSA LNG LLC. Among the solutions that have been selected at the design stage of the Project are:

- The plant has been designed as a zero-flaring plant, where all the normal flaring base line emitters (flare header purging, compressor seal gas vents) have been eliminated. In addition, the following design solutions have been considered:
  - to reduce the natural gas flaring amount, thanks to the small size of the facility and its location in a middle of an industrial area, a methodology using nitrogen has been developed. This methodology has most benefit for the initial start-up but can also be applied after every major shutdown. The methodology consists of starting up the facility under nitrogen and to perform the defrosting operations with it.
  - to achieve a zero-flaring design, Marsa LNG has implemented the recovery of its compressor seal gas for major compressors which use seal gas.
  - The design put in place will include the best-in-class passing valve design and has applied the latest guidance on passing valve identification/ repair. Any identified passing valves can be repaired promptly online under temporary operating procedures.
- A regenerative thermal oxidizer (RTO) has been selected to combust traces of methane remaining in the vented nitrogen of the NRU. The methane will then be converted into CO_2, reducing the associated emissions.
- MR refrigerant composition adjustment valves will not be routed to flare but back to the process. This will also prevent flaring in cases of Main Cryogenic Heat Exchanger leaks develop as these will be recovered instead of being sent to flare.
- All compressors in the LNG plant will be driven by electric motors and the electricity will be drawn from the existing OETC's substation through the Electrical Transmission Line.
- A grid connected solar plant has been planned and is expected to produce electricity in excess of the LNG plant consumption. This will give the potential to consider Scope 2 emissions to be negated provided that sufficient i-RECs are generated by the solar plant

These initiatives proposed for the reduction of GHG emissions for the Marsa LNG development were assessed and summarised by MARSA LNG LLC. and reviewed in in terms of technical and financial feasibility and emission reduction potential.

1.2.2 LNG plant components

The LNG plant will include the following components:

- **Inlet Facilities**: which will include a pressure control station, a filter to remove the particulate matter, and an overpressure protection system.
- **Mercury Removal Unit**: an adsorption system aimed to remove potential mercury present in the feed gas and to avoid mercury amalgam corrosion or liquid metal embrittlement of aluminium equipment in the cryogenic sections of the plant.
- **Acid Gas Removal Unit (AGRU)**: the gas from the mercury removal unit will be sent to the AGRU to remove acid gases (mainly CO2) to prevent freezing in the cryogenic section. The CO2 removal will be done by absorption in an amine-based solvent. CO_2 is then routed to the AGRU Incinerator
- **Dehydration Unit:** it will dry the gas flow to an acceptable level to prevent water freezing and hydrate formation in the cryogenic sections of the LNG plant. The gas will be cooled and then sent to an adsorption unit filled with molecular sieve (three beds, two in operation and one in regeneration).
- **Heavy Hydrocarbon (HHC) Removal Unit**: it will remove heavy hydrocarbons and benzene from the feed gas to a level that prevents freeze out in the liquefaction unit. The HHC Removal Unit will include a demethanizer. The treated gas from the demethanizer overhead will be compressed up to the required liquefaction pressure by a booster compressor. From the bottom of the column, the Natural Gas Liquids (NGL) will be extracted (low-density mixture of hydrocarbon liquids). The condensate will be stabilized in a dedicated downstream unit called the Condensate Stabilization Unit.
- **Liquefaction Unit**: it will cool and liquefy natural gas product. The gas from the HHC Removal Unit and recovered from the Condensate Stabilization Unit will be liquefied in a cryogenic heat exchanger. The LNG product will exit the unit at approximately -150 °C. The refrigerant used for the liquefaction will be a mix of light hydrocarbons and nitrogen. Chilled water production may use the following refrigerant: R134a, R410A, HFO or R717 (ammonia). For the air cooling system, the following refrigerant may be used R134a, R513A, R410A, R32. The operations are intended to use non-ODS (ozone depleting substances) refrigerants and specifically those with a low global warming potential (GWP) (i.e., non-hydrofluorocarbon (HFC) refrigerants). A dedicated storage for the refrigerants (Refrigerant Unit) will be provided with a capacity equal to two (2) times the total inventory of the liquefaction loop.
- **Nitrogen Rejection Unit (NRU) and End Flash Gas Unit:** Nitrogen content in the LNG will be decreased to respect the LNG specifications. The NRU will consist of in cryogenic distillation. A by-product stream of nitrogen will be produced: part of it will be emitted to the atmosphere while another part recycled to the process or used for the LNG plant needs. The nitrogen produced is treated with a thermal oxidiser prior to release to atmosphere to eliminate the fugitive methane emission that could be present in the nitrogen (NRU Incinerator).
- **LNG Storage and Unloading Unit:** The LNG produced will be stored in an onshore tank. The LNG tank will have a capacity of 165,000 m3. The LNG will be loaded to the vessels through dedicated pumps and loading arms suitable for both bunkering vessels and LNG carrier loading. There will be connections to a future LNG truck loading unit with the following characteristics: 3 loading bays for tankers and ISO containers. It is expected that the maximum loading rate during operations will be of 100 m3/h per truck.
- **Boil-Off Gas (BOG) Unit**: All vapours generated during loading system will be returned to the Boil-off Gas Recovery System of the facility, compressed, and send back to the LNG train.
- **AGRU Incinerator**: it will be used to treat the off-gas from the AGRU characterized by the presence of limited quantities of hazardous substance such as Benzene and H2S. The off-gas will be incinerated in a Regenerative Thermal Oxidizer (RTO).

Flare System: it is provided for the reliable and safe disposal of vapour and liquid streams that result from emergencies and plant upsets, and hydrocarbon streams resulting from start-up and shutdown as the plant is stabilised. Flaring will be only allowed during start-up, shut down and in emergency situations. A flare pilot will also be used to ignite the excess gas.

In total, four (4) flares will be present at the site, including:

- Warm flare, cold flare and a common spare flare which will be mounted on a common stack; and
- A low-pressure (LP) cold flare dedicated to the storage and loading operations.

"Multi-arm with variable slot high-pressure (HP) flare tip" technology, able to achieve high combustion efficiency (of 98%) and non-assisted smokeless operation will be used for the flare system, no steam injection is foreseen.

The LNG plant will also include the following key utilities:

- **Fuel gas**: The fuel gas system will be low pressure and will serve the entire facility. The main sources of fuel gas will be:
  - AGRU flash gas;
  - Boil Off Gas (BOG) from the onshore tank;
  - Fuel gas make-up that will preferably be taken downstream of the dehydration unit.

  The fuel gas will be supplied to the site through a dedicated network and will be used by the AGRU and NRU incinerators and the flare pilot.
- **Nitrogen**: it will be used for plant operation and maintenance and will be recovered from the NRU as Liquid Nitrogen and Gaseous Nitrogen. Typically, nitrogen will be used as blanketing gas, purged gas, rotating machines seal gas and also as sweeping gas (e.g., for the flare). Unless necessary, no nitrogen will be imported during operation as nitrogen will be extracted from the feed gas. Recovered nitrogen will be either under gaseous form, so-called Gaseous Nitrogen (GAN), or under liquid state, so-called Liquid Nitrogen (LIN).
- **Service water**: Both process and potable water will be provided to the LNG Plant by an external party inside the Sohar Port. Service and fire water will be stored within the same tank.
- **Demineralized water:** Demineralized water is required for the AGRU operation. A demineralized water package is foreseen with a dedicated tank at site.

In addition, the LNG plant will have a backup diesel generator to supply a minimum number of consumers in case of shutdown, and a fire prevention system.

2. RELEVANT DOCUMENTS AND STANDARDS

2.1 National Standards

Oman has several Royal and Ministerial Decrees that support the study and management of both GHG and ODS. These include both domestic policies and regulations as well as agreements to international treaties that address related issues.

The following is a list of such domestic orders and international agreements which impact this work:

- Montreal Protocol in the year 1987 and its amendments and National Regulations for the Control and Management of the Ozone Depleting Substances;
- Royal Decree No. (119/1994) regarding the Approval of the Accession of the Sultanate of Oman to some International Conventions;
- Royal Decree No. (73/1998) regarding the Ratification of the Vienna Convention on protection of Ozone Layer and Montreal Protocol on substances that deplete the ozone layer and its amendments in London and Copenhagen
- Royal Decree No. (119/94) regarding Ratification of the United Nation Frame Work Convention and Climate Change.
- Royal Decree No. (114/2001) issuing the Law of Conservation of the Environment and Prevention of Pollution;
- Royal Decree No. (106/2004) regarding the Ratification of the Montreal Protocol amendments in Montreal and Beijing.
- Royal Decree No. (107/2004) regarding the Ratification of the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC);
- Royal Decree No. (18/2008) Specifying the Responsibilities of the Ministry of Environment and Climate Affairs and Approving its Organizational Structure;
- Regulations for Obtaining Approvals of Clean Development Mechanism (CDM) Projects under the Kyoto Protocol issued under Ministerial Decision No. (30/2010) and amended by Ministerial Decision 53/2013;
- Issuing Regulations for the Climate Affairs Management under Ministerial Decision No. (18 / 2012).
- Regulations for the protection of the ozone layer.
- Guidelines for the Preparation of the Climate Affairs Chapter in the Environmental Impact Assessment Study for the Projects (2013)
- Ministerial Decision No (20/2016) Issuing the Regulations for the Management of Climate Affairs
- Oman's 2015 Intended Nationally Determined Contribution (INDC) for the United National Framework Convention on Climate Change's 21st Conference of the Parties
- UNFCCC's 2015 "Paris Agreement" (Ratified and Signed by Oman on the 22nd of April 2016)

As per the Ministerial Decision No (20/2016) and the MECA (now EA) Guideline: Form 1 (2017)[1], project aspects and impacts related to climate change need to be assessed as part of an EIA for typically all industrial and infrastructural developments. The extent of the assessment is dependent on MECA climate change thresholds, whereby projects that exceed the thresholds require additional assessment.

The national climate change thresholds for the energy and industrial sector are:

- Production of 2,000 or more metric tons of CO_2 per year; and

[1] Ministry of Environment and Climate Affairs - Form 1 – Guidelines on the preparation of Climate Chapters in EIA (2017).

- Production or consumption of 30 TJ/year.

The EIA assessment should include a description of energy sources and consumption, GHG emission and mitigation, Ozone Depleting Substances (ODS), and climate change impacts and adaption.

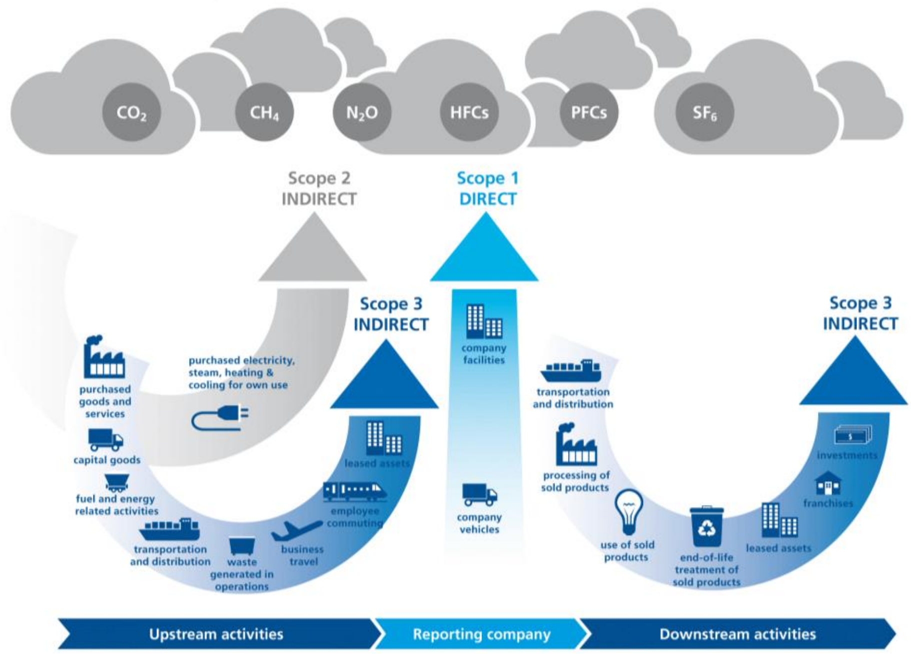
2.2 International Standards

As required per lender standards, defined by the IFC Performance Standards (2012) and the Equator Principles IV (EP4), GHG emissions need to be quantified for Category A as well as B projects.

In accordance with the ISO 14064-1 standard and the GHG protocol, direct and indirect emissions are categorised into three broad scopes (see figure below):

- Scope 1: Direct GHG emissions;
- Scope 2: Indirect GHG emissions from the use of purchased electricity, heat or steam; and
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

These are aligned with the description of different scope emissions under the Ministerial Decision No (20/2016).



Source: WRI & WBCSD 2011[2]

Figure 2.1 Overview of GHG Emission Scopes

[2] World Resource Institute and World Business Council for Sustainable Development (2011) Overview of GHG Protocol scopes and emissions across the value chain. Retrieved from: www.ghgprotocol.org

3. METHODOLOGY

The GHG emissions arising from the LNG bunkering Project have been calculated using the data provided by Marsa Liquefied Natural Gas LLC, which relate to the construction and operational phases of the Project. Data obtained from MARSA LNG LLC was subject to a data quality assessment to ensure accuracy and completeness. Any discrepancies or uncertainties were addressed with MARSA LNG LLC.

The carbon footprint for the construction and operational phases has been estimated in accordance with the standards and guidance listed below:

- Greenhouse Gas (GHG) Protocol: Corporate Accounting & Reporting Standard (World Resources Institute/World Business Council for Sustainable Development)[3]
- American Petroleum Institute (API) 2021, which provides industry-specific emission factors applicable to the LNG sector[4].

Solely the direct facilities and activities owned by the Project, as listed in Section 1, are considered in this assessment. Therefore, in line with IFC and EP4 requirements as well as the Omani requirements, the operational boundaries of this GHG Assessment include Scope 1 and 2 emissions. Fugitive emissions have not been estimated as part of this GHG inventory due to a lack of available data, however quantification of these should be included as the design progresses

The GHG inventory includes CO_2, Methane (CH_4) and Nitrous Oxide (N_2O). The inventory excludes Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur Hexafluoride (SF_6) and Nitrogen Trifluoride (NF_3). Quantification of emissions from fluorinated gases should be developed as the design matures, given that they will be present in the plant.

To date, refrigerants have not been included as part of this GHG inventory due to lack of available information. As the design matures, quantification of any emissions from refrigerants used should be included in the GHG inventory.

Regarding the Scope 1 emissions, two cases (a base case and a high case) are considered in Section 4.2 for operations with differing CO2 emissions levels, in order to represent varying project design options. Different AGRU Acid gas flowrates of identical compositions are specified in these two cases.

Scope 3 emissions are excluded from the ESIA.

The following key assumptions are made in the development of the GHG inventory:

- IPCC AR6 Global Warming Potentials are used.

A 98% combustion efficiency for flaring operations is assumed Section 4 below outlines the Project's Scope 1 and 2 emissions for the construction phase and the operational phase.

[3] Available online at: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

[4] API (2021) Compendium of Greenhouse Gas Emissions Methodologies for the Natural Gas and Oil Industry.

4. PROJECT GHG EMISSIONS

An outline of the data received, and the specific calculations made in this assessment, are provided in Annex 2. The following highlights the main results of the GHG calculations for each project phase. The construction and pre-commissioning phases are expected to last 34 months and the operational phase is expected to last 25-years. For simplicity, the pre-commissioning phase emissions have been reported with the construction phase emissions.

4.1 Construction Phase GHG Emissions

During the construction phase, GHG emissions will be generated from the following activities:

- Operation of vehicles used during construction/pre-commissioning works (i.e., excavators, bulldozers, trucks, and cars);
- Operation of power generators to supply energy during the construction/pre-commissioning works as well as for the admin offices, labour camps and other ancillary facilities.
- Potential losses of refrigerants in HVAC systems used for offices, accommodation and vehicles

Table 4.1 outlines the total fuel consumption for the construction phase.

4.1.1 Construction Phase Energy Consumption

Table 4.1 Estimated Total Energy Consumption of the Construction Phase

#	Project Stage	Liquid fuel	Gaseous fuel	Solid fuel	Electricity
1	Construction Phase[5]	31,025,000l (Diesel)[6]	There are not anticipated to be any gaseous fuel requirements during construction.	There are not anticipated to be any solid fuel requirements during construction.	There will be no purchased electricity from the grid during construction

4.1.2 Construction Phase: Scope 1 Emissions

The GHG emissions reported in this section are related to the operation of the above-mentioned equipment and more specifically the consumption of an estimated 30,000 l/day of diesel. The fuel consumption is converted into GHG emissions using the emissions factors listed in Annex 2. In the following Table 4.2 annual Scope 1 related to the construction phase are highlighted.

Table 4.2 Annual Scope 1 Emissions During Construction Phase

Equipment	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2eq [ton/y]
Diesel Generators, Construction Equipment, Heavy Vehicles, Light Vehicles, Admin Offices, Labor Camps	29,833	1.20	0.24	29,932

[5] The estimations for energy consumption during construction are provided for the overall project and are expected to include diesel consumption for on-site power production used for construction, in the admin offices and labor camps, as well as in the heavy and light vehicles used for construction. This information will be updated during actual construction activities (e.g. auditing of construction works)

[6] Construction is expected to last 34-months, it is estimated that consumption will be 30,000 L/day

4.1.3 Construction Phase: Scope 2 Emissions

There will not be any Scope 2 emissions during construction for this project because no grid-connected electricity or purchased utilities such as steam, heating, or cooling will be used during the construction of the Project.

4.1.4 Total Emissions During Construction Phase

The annual emissions for each Scope during the Construction Phase are summarised in the following table.

Table 4.3 Emissions During Construction Phase

Annual emissions [ton CO_2e /y]	29,932
Total emissions [ton CO_2 over 34 months]	84,809

4.2 Operational Phase GHG Emissions

During the operational phase, GHG emissions will be generated by the following equipment:

- AGRU Incinerator (Thermal Oxidiser): emissions produced from combustion of fuel gas, incineration of acid gas and direct release of CO_2 in the acid gas;
- Flaring system (cold/warm flare): emissions produced from the combustion of flare gas;
- NRU incinerator: emissions from incineration of trace methane (100 ppm) in nitrogen vented from the NRU;

Moreover, GHG emissions will be released due to non-routine flaring during start-up, which is expected to happen according to the following scheme:

- 7133 tonnes of feed gas flared at initial start-up (this has been annualised for the GHG inventory);
- 3380 tonnes of feed gas flared at start-up after maintenance[7] (this has been annualised for the GHG inventory);
- 1128 tonnes/year of other flaring e.g. at start-up after trips, upsets and relief etc.

GHG emissions related to the continuous operation of the flare pilot and non-routine flaring during start-up were calculated using the methodology from API (2021) for flares which makes use of a 98% flare combustion efficiency. The emissions related to CO_2, N_2O and CH_4 were determined based on gas composition and the emissions factors, also provided by the API (2021), all of which can be found in Annex 1.

Following these calculations, GHG emissions, expressed in terms of both primary emissions and CO_2 equivalent (CO_2e), were computed using Global Warming Potential (GWP) factors which can be found in Annex 1.

4.2.1 Operational Phase Energy Consumption

During the operational phase of the Project, energy consumed comes from natural gas and electricity that is used for the offices, warehouses and compressors for the LNG train. No information is known on the potential consumption of diesel for the backup generator, however, it is expected that this will be negligible in terms of both total energy consumed and resulting GHG emissions for the project.

[7] According to the Project Description Section 3.5, the planned shutdown of the plant for maintenance activities is scheduled every 4 years lasting for 21 days. The main activities will be related to corrective or preventive maintenance on all major equipment to ensure their reliability during operation.

Table 4.4 gives an estimate of the annual energy consumption during the operational stage. In the subsequent table, Table 4.5, the energy consumption is broken down by consumer.

Table 4.4 Estimated Annual Energy Consumption During Operation

Project Phase	Liquid fuel	Gaseous fuel	Solid fuel	Electricity
Operational Phase	An unknown amount of diesel will be consumed for the infrequent use of a backup generator, but this is assumed to be insignificant compared to the overall energy demand nor the overall contributions to the GHG assessment	464,280 kg/year Natural Gas	There are not anticipated to be any solid fuel requirements during operation.	700,800 MWh

Table 4.5 Annual Gaseous Energy Usage During Operational Phase Breakdown

#	Consumer	Annual Consumption	Percentage Contribution
1	AGRU Incinerator	350,400 kg/year	75.5%
2	Flare Pilot	113,880 kg/year	24.5%
	Total	464,280 kg/yr	

The below Table 4.6 provides information on all other non-gaseous energy uses during operations such as electricity.

Table 4.6 Annual Electricity Consumption during Operations

#	Categories	Value (MWh)	%
1	Offices, Warehouses, Accommodations: Air Conditioning / Ventilation	28,295	4.2%
2	Offices, Warehouses, Accommodations: Lighting	4,993	0.7%
3	Offices, Warehouses, Accommodations: Computers/Office Equipment / Appliances	4,161	0.6%
4	Offices, Warehouses, Accommodations: Hot Water	2,081	0.3%
5	Offices, Warehouses, Accommodations: Other	2,081	0.3%

6	Production: Compressors	624,150	93.8%
7	Backup Generators	N/A	N/A
Total		**700,800**	**100%**

4.2.2 Operational Phase: Scope 1 Emissions

The gas flow rate and annual Scope 1 GHG emissions are shown in Table 4.7 for the low CO2 emissions option of the Base Case, while the high CO2 alternative is considered in the subsequent Table 4.8. The subsequent Table 4.9 separately describes the flare gas emissions sources of the LNG plant.

Table 4.7 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (Base Case)

Equipment	Gas consumption [kg/h]	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2e [ton /y]
AGRU Incinerator	Fuel gas: 40	942	0.02	0.00	942
	Acid gas: 2400	19,363	-	-	19,363
Flaring pilot	Flare gas: 13	215	1.60	0.00	260
NRU Incinerator	Exhaust gas: 4300	97.7	0.18	-	103
Base Case Total (without flaring)	-	20,524	0.20	0.00	20,530
Base Case Total (with flaring at start-up)	-	21,557	7.47	0.00	21,766
Base Case Total (with flaring)	-	24,542	28.6	0.01	25,341

Table 4.8 Fuel Gas Consumption and Annual Scope 1 GHG Emissions during Operational Phase (High CO_2 Case)

Equipment	Gas consumption [kg/h]	CO_2 [ton/y]	CH_4 [ton/y]	N_2O [ton/y]	CO_2e [ton /y]
AGRU Incinerator	Fuel gas: 40	942	0.02	0.00	942
	Acid gas: 6,153	49,642	-	-	49,642
Flaring pilot	Flare gas: 13	215	1.60	0.00	260
NRU Incinerator	Exhaust gas: 4300	97.7	0.18	-	103
High Case Total (without flaring)	-	**50,995**	**0.20**	**0.00**	**51,001**
High Case Total (with flaring at start-up)	-	**52,028**	**7.47**	**0.00**	**52,236**
High Case Total (with flaring)	-	**55,012**	**28.6**	**0.01**	**55,811**

Table 4.9 Annual Gaseous Sources of Emissions During Operational Phase

#	Flaring Scenario	Flowrate	Percentage
1	Initial Start-Up Flaring	285,320 kg/year	18.4%
2	Start-Up after Maintenance	135,200 kg/year	8.7%
3	Other Flaring (after trips, upsets, relief etc.)	1,128,000 kg/year	72.8%
4	Fugitive emissions	Not quantified to date	
5	Fluorinated gases	Not quantified to date	
	Total	**1,548,520 kg/year**	**100.0%**

4.2.3 Operational Phase: Scope 2 Emissions

From the LNG Project, the only contribution to Scope 2 emissions will be the use of grid electricity to power the compressors and other equipment associated with the LNG Train and the building's facilities (e.g., lighting, office equipment, etc.). The total electricity consumption estimated per year is 700,800 MWh. This is broken down by user in Table 4.6.

There will not be any other Scope 2 emissions during operations for this project because there are no other purchased utilities such as steam, heating or cooling. The total Scope 2 emissions per year are highlighted in the below Table 4.10.

MARSA LNG LLC is separately developing a solar plant that will be connected to the national grid, and the LNG plant will take electricity from this grid. There is no direct connection from the solar plant to the LNG Plant. In the daytime, the LNG plant will be consuming the equivalent of approximately 44% of the electricity produced by the PV plant and will draw from the grid during the night. The LNG project is intending to claim zero Scope 2 emissions on the basis of i-RECs generated by the PV plant, which will require an appropriate contractual relationship between the LNG plant and the solar plant and will require the PV project to be registered to provide those RECs. GHG Protocol accounting is currently on an annual basis so an equivalent number of iRECs (MWh basis) to the MWh of electricity imported to the facility in a given year will be required in order to be able to report zero scope 2 emissions. It is advised to follow the GHG Scope 2 Protocol for market-based emissions accounting, including how to handle volume not matched with attribute certificates. The i-RECs will need to be transferred to Marsa LNG as part of the contractual arrangement, in order to allow retirement and to prevent possible double claiming. As such, the annual Scope 2 emissions are indicated in Table 4.10.

Table 4.10 Annual Scope 2 Emissions During Operation Phase

Item	Electricity [MWh/y]	CO_2e without Solar Plant [ton/y]	CO_2e with Solar Plant [ton/y]
Electricity	700,800	260,445	0

4.2.4 Total Emissions During Operational Phase

The total emissions for each Scope during the Operational Phase are summarised in Table 4.11.

Table 4.11 Total Emissions During Operational Phase

Scope	Emissions (Base Case) [tCO_2e/y]	Emissions (High CO_2 Case) [tCO_2e/y]
Scope 1	25,341	55,811
Scope 2 (with solar plant)	0	0
Scope 3	n/a	n/a
Total	**25,341**	**55,811**

4.3 Summary of Construction and Operations Emissions

Table 4.12 serves as a comprehensive summary of emissions and provides a clear overview of the GHG emissions associated with the Project's construction and operational phases per year and per the Project's lifetime.

Table 4.12 GHG Emissions for each Project Phase

Scope	Base Case		High CO_2 Case	
	Annual Emissions [tCO_2 e/year]	Total Emissions [tCO_2 e]	Annual Emissions [tCO_2 e/year]	Total Emissions [tCO_2 e]
Construction and Pre-Commissioning Phase				
Scope 1	29,932	84,809 (over 34 months)	29,932	84,809 (over 34 months)
Scope 2	0	0	0	0
Total	**~30,000**	**~85,000 (over 34 months)**	**~30,000**	**~85,000 (over 34 months)**
Operational Phase				
Scope 1	25,341	633,517 (over 25 years)	55,811	1,395,270 (over 25 years)
Scope 2	**0**	**0**	**0**	**0**
Total	**~ 25,000**	**~ 634,00 (over 25 years)**	**~56,000**	**~1,395,000 (over 25 years)**

4.4 Ozone Depleting Substances

This section identifies the machinery and devices responsible for consuming and emitting Ozone-Depleting Substances (ODS) and Non-Ozone-Depleting Substances (Non-ODS) during both the construction and operational phases of the Project. In particular, it focuses on the potential utilization of non-ODS refrigerants throughout the Project.

4.4.1 Application of ODS and Non-ODS

The most noteworthy application of refrigerants occurs during the "liquefaction" process within the LNG Plant. It's worth noting that the pre-cooling, cooling, and liquefaction phases can involve a variety of refrigerants, including both ODS and non-ODS types. It is worth to note that the use of ODS is minimal and is therefore highly unlikely to have an impact on the atmosphere.

Non-ODS refrigerants, while not harmful to the stratospheric ozone layer, can still possess a significant GWP value, however, MARSA LNG LLC intends to employ a combination of nitrogen, methane, and other hydrocarbons like propane, all of which have relatively low GWP values when compared to alternatives. Furthermore, certain cooling processes will involve the use of air instead of water, primarily in industrial operations and LNG production. Nonetheless, there may be potential applications of appliances and equipment, especially air conditioners, during both the construction and operational phases.

However, Ozone Depleting Substances are employed so sparingly in this project that further assessment is unnecessary. MARSA LNG LLC will strictly adhere to the Montreal Protocol, which Oman has ratified, in phasing out high GWP refrigerants like HCFCs and specific HFCs.

5. SITUATION OF PROJECT GHG EMISISONS WITHIN NATIONAL AND INTERNATIONAL CONTEXT

5.1 Introduction

The purpose of this chapter is to provide a comprehensive understanding of the greenhouse gas (GHG) emissions associated with the Project in the broader context of national and international guidelines. This analysis aims to assess whether the expected operational GHG emissions from the Project are considered 'significant' based on the established international guidance, while considering national GHG reduction goals, namely Oman' Nationally Determined Contributions[8] (NDCs) to the Paris Agreements.

5.2 Oman' NDCs

Oman, as a responsible member of the global community, has outlined its commitment to combat climate change through its Nationally Determined Contributions (NDC). The NDC focuses on driving the transition towards a low-carbon economy, with a specific target of achieving a 7% reduction in greenhouse gas emissions compared to the Business as Usual (BAU) scenario by the year 2030. Furthermore, Oman aims to attain a zero operational emissions energy sector by 2050 and eliminate routine flaring by 2030.[9]

5.3 Comparison to international thresholds

To evaluate the significance of the Project' GHG emissions, a comparison will be made against the International Finance Corporation's (IFC) magnitude scale for project GHG emissions. The IFC classifies the magnitude of GHG impacts[10] as represented in the following table.

Table 5-1 Magnitude Scale for Project GHG Emissions (per IFC)

Project-Wide GHG Emissions/annum	Scale Rating
>1,000,000 tCO_2e	Very Large
100,000 – 1,000,000 tCO_2e	Large
25,000 – 100,000 tCO_2e	Medium
5,000 - 25,000 tCO_2e	Small
<5,000 tCO_2e	Negligible

Based on the above information, the potential magnitude scale of the Projects operational GHG emissions, ranging in between 30,000 and 56,000 tons of CO2 e per year, is Medium.

5.4 Situation of the Project within the NDC and international thresholds

With the Project intending to source all of its electricity from a solar plant during operations (and retire relevant iRECs), resulting in zero Scope 2 emissions, and actively minimizing flaring, the overall emissions profile reflects a commitment to the country' NDC. The exclusion of ozone-depleting substances further aligns with environmentally conscious practices. The Project in operation does, nevertheless, emit a substantial amount GHG emissions, classified as Medium according to the IFC magnitude thresholds. However, in comparison to Oman' national GHG emissions, estimated at

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[8] Sultanate of Oman (2021) Second NDC Report. Available at: [Second NDC Report Oman.pdf (unfccc.int)]

[9] Sultanate of Oman (2021) Second NDC Report. Available at: [Second NDC Report Oman.pdf (unfccc.int)]

[10] International Finance Corporation Performance Standard 3 – Resource Efficiency and Pollution Prevention (2012):

around 90 million tons of CO2 e in 2021[11], the Project in operation would emit a share of 0.0006222%[12] of Oman' total GHG emissions, thus may be considered to have a minor contribution to national GHG emissions. Furthermore, the contribution of the Project to supply LNG fuel for shipping must be acknowledged as a crucial aspect in the long-term reduction of emissions in the shipping industry. This aligns with global efforts to transition towards less emissions-intensive fuels.

6. RECOMMENDATIONS

The resulting emissions from the Project, shown in Table 4.12, indicate that the threshold defined by the Omani Ministerial Decision No.(20/2018) of 2,000 metric tonnes of CO2e/y is surpassed for the Project's emissions during construction and operation. According to the Regulations for the Management of Climate Affairs[13] the Project unequivocally falls within the category of projects and establishments listed in Annex B of the Omani Ministerial Decision 20-16. The EIA assessment should include a description of energy sources and consumption, GHG emission and mitigation, Ozone Depleting Substances (ODS), and climate change impacts and adaption.

As a result, it is imperative for the Project to adhere to the regulatory requirements outlined in the aforementioned excerpt from the Omani Ministerial Decision. This includes obtaining the necessary licenses and submitting annual reports on GHG emissions, as well as their reduction measures and maintaining detailed records of compliance with the license's requirements. The project must ensure strict adherence to these obligations to align with local environmental regulations and contribute to sustainable and responsible project management. In addition to the carbon reduction measures the Project has inherently embedded in its design, further initiatives to reduce emissions were considered for the Project as required by the Guidelines for the Preparation of Climate Affairs Chapter in the EIA Study for the Projects (2013). These are shown in Annex 3.

Moreover, in alignment with the guidance set out by the Equator Principles 4 (EP4) (published in July 2020) and the accompanying 'Guidance Note on Climate Change Risk Assessments' (published in May 2023, and collectively referred to as the 'CCRA guidance'), when combined Scope 1 and Scope 2 emissions are expected to exceed 100,000 tonnes of CO_2 equivalent annually a transition Climate Change Risk Assessment (CCRA) and GHG alternatives analysis is required. With electricity supplied by the solar plant, the total emissions fall below this threshold. Since the solar plant will provide electricity to the grid and the LNG plant will consume energy from the grid, the Scope 2 emissions can be considered to be negated provided that sufficient i-RECs are generated by the solar plant, transferred to the LNG plant and retired. Furthermore, a contract will be required with the Omani grid authorities; it is understood this is currently under negotiation.

As the design develops, quantification of fugitive emissions should be included in the GHG inventory, together with development of project specific emissions factors.

[11] Oman Energy Agency (2022) Net Zero report. Available at: https://www.ea.gov.om/media/aaslyc3l/oman-net-zero-report-2022_screen.pdf

[12] 56 000 tons of CO2 e per year / 90 000 000 tons of CO2 e per year = 0.0006222 tons of CO2 e per year

[13] Omani Ministry of Environment and Climate Affairs (2016) Omani Ministerial Decision No.(20/2018).

ANNEX 1: CONVERSION FACTORS

Global Warming Potentials

Table 1. GWP values relative to CO2 (GWP values for 100-year time horizon)

Component	GWP
CO_2	1
CH_4	27.9
N_2O	273

Source: IPCC AR6

Emission Factors

Table 2. Emission Factors

Densities and HHV					
	HHV	Units	Density	Units	Reference
Diesel	0.0387	TJ / m3 diesel			API 2021
NG (AGRU)	38	MJ / m3 NG	0.6728	kg / m3	Composition provided by Client
					Composition provided by Client
Flare gas (Pilot)	27.31	MJ / m3 flare gas	0.7775	kg / m3	Composition provided by Client
Flare gas (Others)	32.8	MJ / m3 flare gas	0.7273	kg / m3	Composition provided by Client

Emission Factors	CO2	Units		CH4	Units		N2O	Units
Construction EF	Diesel Stationary (API 2021)							
Emission factor (CO2)	70.4	tonnes / TJ diesel	Emission factor (CH4)	0.0028	tonnes / TJ diesel	Emission factor (N2O)	0.0006	tonnes / TJ diesel
Emission factor (CO2)	2.72	kg CO2 / litre diesel	Diesel emission factor (CH4)	0.0001	kg CH4 / tonne fuel	Diesel emission factor (N2O)	2.20E-05	kg N2O / tonne fuel
AGRU EF	NG Stationary (API 2021)							
Emission factor (CO2)	50.10	tonnes CO2 / TJ NG	Emission factor (CH4)	0.0009	tonnes CH4 / TJ NG	Emission factor (N2O)	9.48E-05	
NG emission factor (CO2)	2,830	kg CO2 / tonne NG	NG emission factor (CH4)	0.0535	kg CH4 / tonne NG	NG emission factor (N2O)	5.35E-06	kg N2O / tonne NG
Emission factor (CO2)	Calculated on composition basis.		Emission factor (CH4)	Calculated on composition basis.		Emission factor (N2O)	No published N2O emission factors for thermal oxidiser (API 2021)	
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)		
AGRU EF								
Emission factor (CO2)	Calculated on composition basis.		Emission factor (CH4)	Calculated on composition basis.		Emission factor (N2O)	No published N2O emission factors for	

Emission Factors	CO2	Units		CH4	Units		N2O	Units
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)	thermal oxidiser (API 2021)	
Flaring EF	(API 2021)							
Flare Pilot EF (CO2)	Calculated on composition basis.		Flare Pilot EF (CH4)	Calculated on composition basis.		Flare Pilot EF (N2O)	3.33E-06	EF (kg N2O / kg flare gas)
Initial Start-Up EF (CO2)			Initial Start-Up EF (CH4)			Initial Start-Up EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Start-up after Maintenance EF (CO2)			Start-up after Maintenance EF (CH4)			Start-up after Maintenance EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Other Flaring EF (CO2)			Other Flaring EF (CH4)			Other Flaring EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Electricity Grid Factor	IEA emissions factors							

ANNEX 2: GHG INVENTORY CALCULATIONS

GHG Emissions									
Construction Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
Construction Diesel Used	30,000.00	liters / day							
Resulting Emissions	81,734.40	kg CO2 / day	3.30	kg Ch4 / day	0.66	kg N2O / day			
Resulting Emissions	29,833,056.00	kg CO2 / year	1,203.49	kg CH4 / year	241.12	kg N2O / year			
Resulting Emissions	**29,833.06**	**tonnes CO2 / year**	**1.20**	**tonnes CH4 / year**	**0.24**	**tonnes N2O / year**	**29,932.46**	**tonnes CO2e / year**	
Annualised Emissions	**84,526.99**	**tonnes CO2 / construction lifetime of 34months**	**3.41**	**tonnes CH4 / construction lifetime of 34 months**	**0.68**	**tonnes N2O / construction lifetime of 34 months**	**84,808.64**	**tonnes CO2e / construction lifetime of 34 months**	
Scope 1 Operational Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
AGRU Emissions									
Emissions from Fuel Gas									
Incinerator Fuel Flow Rate (methane)	38.00	kg / hour							
Incinerator Fuel Flow Rate (methane)	0.04	tonne / hour							
Resulting Emissions	107.53	kg CO2 / hour	0.00	kg CH4 / hour	0.00	kg N2O / hour			Assumed 100% efficiency. No stated guidance in API Compendium
Resulting Emissions	2,580.66	kg CO2 / day	0.05	kg CH4 / day	0.00	kg N2O / day			
Resulting Emissions	941,939.57	kg CO2 / year	17.82	kg CH4 / year	0.00	kg N2O / year			
Resulting Emissions	**941.94**	**tonnes CO2 / year**	**0.02**	**tonnes CH4 / year**	**0.00**	**tonnes N2O / year**	**942.44**	**tonnes CO2e / year**	
Emissions from Direct CO2 Release									
Acid Gas Flow Rate	2,400.00	kg / hour							
Incinerator Acid Flow Rate	2,280.00	kg / hour							
CO2 Flow Rate (direct release)	2,210.43	kg CO2 / hour							
Resulting Emissions	53,050.35	kg CO2 / day							
Resulting Emissions	19,363,378.08	kg CO2 / year							
Resulting Emissions	**19,363.38**	**tonnes CO2 / year**					**19,363.38**	**tonnes CO2e / year**	
Emissions from Incineration									
Incineration Flow Rate	4.16	kg / hour						AGRU flowrate 6153 kg/hr from ESIA	
Incineration Flow Rate	0.00	tonne / hour							
Resulting Emissions	13.92	kg CO2 / hour	-	kg CH4 / hour	-	kg N2O / hour			Assumed 100% efficiency. No stated guidance in API Compendium
Resulting Emissions	334.05	kg CO2 / day	-	kg CH4 / day	-	kg N2O / day			
Resulting Emissions	121,928.36	kg CO2 / year	-	kg CH4 / year	-	kg N2O / year			
Resulting Emissions	**121.93**	**tonnes CO2 / year**	**-**	**tonnes CH4 / year**	**-**	**tonnes N2O / year**	**121.93**	**tonnes CO2e / year**	
Total Emissions from AGRU	**20,427.25**	**tonnes CO2 / year**	**0.02**	**tonnes CH4 / year**	**0.00**	**tonnes N2O / year**	**20,427.74**	**tonnes CO2e / year**	
NRU Emissions									
Emissions from Methane Incineration									
Methane Flow Rate			35,784.60	kg / year					95% Availability Factor applied to the CH4 flowrate, otherwise assumed operational at 24 hours per day, 365 days per year.
Resulting Emissions	97.68		0.18	tonnes CH4 / year	-	tonnes N2O / year	102.67	tonnes CO2e / year	Assumed 99.5% methane combustion
Total Emissions from NRU	**97.68**	**tonnes CO2 / year**	**0.18**	**tonnes CH4 / year**	**-**	**tonnes N2O / year**	**102.67**	**tonnes CO2e / year**	
Flaring Emissions									
Flare Pilot	108,186.00	kg / year							Availability Factor of 95% applied here.
Initial Start-Up	285,320.00	kg / year							
Start-up after Maintenance	135,200.00	kg / year							
Other Flaring (after trips, upsets, relief etc)	1,128,000.00	kg / year							
Total Flaring	1,656,706.00	kg / year							
Resulting Emissions Flare Pilot	214.91	tonnes CO2 / year	1.60	tonnes CH4 / year	0.00	tonnes N2O / year	**259.61**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Initial Start-Up	700.50	tonnes CO2 / year	4.93	tonnes CH4 / year	0.00	tonnes N2O / year	**838.47**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Start-up after Maintenance	331.94	tonnes CO2 / year	2.34	tonnes CH4 / year	0.00	tonnes N2O / year	**397.31**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Other Flaring (after trips, upsets, relief etc)	2,769.40	tonnes CO2 / year	19.50	tonnes CH4 / year	0.00	tonnes N2O / year	**3,314.86**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Total Emissions from Flaring	**4,016.75**	**tonnes CO2 / year**	**28.37**	**tonnes CH4 / year**	**0.01**	**tonnes N2O / year**	**4,810.25**	**tonnes CO2e / year**	
Scope 2 Operational Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
Electricity-Related Emissions									
Emissions from Production							244,167.48	tonnes CO2e / year	
Emissions from Offices							16,277.83	tonnes CO2e / year	
Total Emissions from Electricity Consumption							**260,445.31**	**tonnes CO2e / year**	
Emissions Summary									
Scope 1 Emissions During Operations (Without Flaring)	20,524.92	tonnes CO2 / year	0.20	tonnes CH4 / year	0.00	tonnes N2O / year	20,530.41	tonnes CO2e / year	
Scope 1 Emissions During Operations (With Flaring)	24,541.67	tonnes CO2 / year	28.57	tonnes CH4 / year	0.01	tonnes N2O / year	25,340.66	tonnes CO2e / year	
Lifetime Scope 1 Emissions During Operations (Without Flaring)	513,123.09	tonnes CO2 / project lifetime of 25 years	4.92	tonnes CH4 / project lifetime of 25 years	0.00	tonnes N2O / project lifetime of 25 years	513,260.33	tonnes CO2e / project lifetime of 25 years	
Lifetime Scope 1 Emissions During Operations (With Flaring)	613,541.83	tonnes CO2 / project lifetime of 25 years	714.23	tonnes CH4 / project lifetime of 25 years	0.17	tonnes N2O / project lifetime of 25 years	633,516.62	tonnes CO2e / project lifetime of 25 years	
Total (with flaring at start-up)	21,557.36	tonnes CO2 / year	7.47	tonnes CH4 / year	0.00	tonnes N2O / year	21,766.20	tonnes CO2e / year	
Scope 2 Emissions During Operations without Solar Plant							260,445.31	tonnes CO2e / year	
Lifetime Scope 2 Emissions During Operations							6,511,132.80	tonnes CO2e / project lifetime of 25 years	
Scope 2 Emissions During Operations with Solar Plant							**0.00**	**tonnes CO2e / year**	
Total Emissions During Operations without Solar Plant (Without Flaring)							280,975.73	tonnes CO2e / year	
Total Emissions During Operations without Solar Plant (With Flaring)							285,785.98	tonnes CO2e / year	
Total Emissions During Operations with Solar Plant (Without Flaring)							**20,530.41**	**tonnes CO2e / year**	
Total Emissions During Operations with Solar Plant (With Flaring)							**25,340.66**	**tonnes CO2e / year**	
Lifetime Emissions During Operations without Solar Plant (Without Flaring)							7,024,393.13	tonnes CO2e / project lifetime of 25 years	
Lifetime Emissions During Operations without Solar Plant (With Flaring)							7,144,649.42	tonnes CO2e / project lifetime of 25 years	
Lifetime Emissions During Operations with Solar Plant (Without Flaring)							**513,260.33**	**tonnes CO2e / project lifetime of 25 years**	
Lifetime Emissions During Operations with Solar Plant (With Flaring)							**633,516.62**	**tonnes CO2e / project lifetime of 25 years**	

Energy				
Construction			Percentages	Notes
Diesel Consumption	30,000.00	liters / day		
Diesel Consumption	10,950,000.00	liters / year		
Diesel Consumption	27,375,000.00	liters / construction period of 30 months		
Operations				
AGRU Incinerator Fuel Flow Rate	40.00	kg / hour		
AGRU Incinerator Fuel Flow Rate	350,400.00	kg / year	17.4%	
AGRU Incinerator Fuel Flow Rate	8,760,000.00	kg / project lifetime of 25-years		
Flare Pilot	13.00	kg / hour		Continuous routine flaring
Flare Pilot	113,880.00	kg / year	5.7%	
Flare Pilot	2,847,000.00	kg / project lifetime of 25-years		
	781.70			
Initial Start-Up	285,320.00	kg / year	14.2%	
Initial Start-Up	7,133,000.00	kg / project lifetime of 25-years		
	370.41			
Start-up after Maintenance	135,200.00	kg / year	6.7%	
Start-up after Maintenance	3,380,000.00	kg / project lifetime of 25-years		
	3,090.41			
Other Flaring (after trips, upsets, relief etc)	1,128,000.00	kg / year	56.0%	
Other Flaring (after trips, upsets, relief etc)	28,200,000.00	kg / project lifetime of 25-years		
Annual Energy Consumption During Operation (Without Flaring)	350,400.00			
Energy Consumption During Entire Project Lifetime of 25-Years (Without Flaring)	8,760,000.00			
Annual Energy Consumption During Operation (With Flaring)	2,012,800.00			
Energy Consumption During Entire Project Lifetime of 25-Years (With Flaring)	50,320,000.00			

Energy				
Operations		Units	Percentages	**Notes**
Offices, Warehouses, Accomodations: Air Conditioning / Ventilation	28,294,800.00	kWh	4.250%	Updated assumptions from Total that buildings will use 5 MWe of power on average. TPC/ERM notes that this seems high, and actually it is not higher than our previous model presented in version 1.6 of the Excel. In version 1.6, Total also said the value it already high, but Total has now requested the value to be even higher. So, there might be some confusion here. TPC/ERM's further extrapolation that, of this we can assume 68% is for cooling, 12% is for lighting, 10% is for computers/appliances, 5% Water Heating, and 5% other. A 95% availability factor is applied, and consumption is annualized at 24 hours per day, 365 days per year of electricity consumption.
Offices, Warehouses, Accomodations: Lighting	4,993,200.00	kWh	0.750%	
Offices, Warehouses, Accomodations: Computers/Office Equipment / Appliances	4,161,000.00	kWh	0.625%	
Offices, Warehouses, Accomodations: Hot Water	2,080,500.00	kWh	0.313%	
Offices, Warehouses, Accomodations: Other	2,080,500.00	kWh	0.313%	
Production: Compressors and Other	624,150,000.00	kWh	93.750%	Compressors for the LNG Train. The power profile is set at 76 Mwe for the plant processes as was defined by Total during the GHG review process. A 95% availability factor is applied, and consumption is annualized at 24 hours per day, 365 days per year of electricity consumption.
Backup Generators	N/A	N/A	N/A	No information is known on the potential consumption of diesel for the backup generator, however it is expected that this will be negligible in terms of both total energy consumed and resulting GHG emissions for the project
Total	**665,760,000.00**	kWh	100.000%	

GWPs	(IPCC AR6)
GHG	GWP values for 100-year time horizon
CO_2	1
CH_4	27.9
N_2O	273

Densities and HHV					
	HHV	Units	Density	Units	Reference
Diesel	0.0387	TJ / m3 diesel			API 2021
NG (AGRU)	38	MJ / m3 NG	0.6728	kg / m3	ISO 6976
Acid gas (AGRU)		MJ / m3 acid gas		kg / m3	ISO 6976
Flare gas (Pilot)	27.31	MJ / m3 flare gas	0.7775	kg / m3	ISO 6976
Flare gas (Others)	32.8	MJ / m3 flare gas	0.7273	kg / m3	ISO 6976

Emission Factors	CO2	Units		CH4	Units		N2O	Units
Construction EF	Diesel Stationary (API 2021)							
Emission factor (CO2)	70.4	tonnes / TJ diesel	Emission factor (CH4)	0.0028	tonnes / TJ diesel	Emission factor (N2O)	0.0006	tonnes / TJ diesel
Emission factor (CO2)	2.72	kg CO2 / litre diesel	Diesel emission factor (CH4)	0.0001	kg CH4 / tonne fuel	Diesel emission factor (N2O)	2.20E-05	kg N2O / tonne fuel
AGRU EF	NG Stationary (API 2021)							
Emission factor (CO2)	50.10	tonnes CO2 / TJ NG	Emission factor (CH4)	0.0009	tonnes CH4 / TJ NG	Emission factor (N2O)	9.48E-05	
NG emission factor (CO2)	2,830	kg CO2 / tonne NG	NG emission factor (CH4)	0.0535	kg CH4 / tonne NG	NG emission factor (N2O)	5.35E-06	kg N2O / tonne NG
Emission factor (CO2)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (CH4)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (N2O)	No published N2O emission factors for thermal oxidiser (API 2021)	
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)		
AGRU EF								
Emission factor (CO2)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (CH4)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (N2O)	No published N2O emission factors for thermal oxidiser (API 2021)	
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)		
Flaring EF							(API 2021)	
Flare Pilot EF (CO2)	Calculated on composition basis. See "Other Inputs" tab		Flare Pilot EF (CH4)	Calculated on composition basis. See "Other Inputs" tab		Flare Pilot EF (N2O)	3.33E-06	EF (kg N2O / kg flare gas)
Initial Start-Up EF (CO2)			Initial Start-Up EF (CH4)			Initial Start-Up EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Start-up after Maintenance EF (CO2)			Start-up after Maintenance EF (CH4)			Start-up after Maintenance EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Other Flaring EF (CO2)			Other Flaring EF (CH4)			Other Flaring EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)

Electricity Grid Factor	IEA (2022)	
Emission factor (CO2e)	[redacted]	gCO2/kWh
Solar emission factor (CO2e)		gCO2/kWh

Due to licensing agreements by IEA with ERM, the factors cannot be shared with anyone outside of Total's business (apart from auditors), and cannot be disclosed in the public domain. Total can state that IEA emissions factors were used, but is not permitted to provide the value of X

Total's Suggested EF for Electricity

Amount of fuel used per kWh = Heat rate (in British Thermal Units (Btu) per kWh) / Fuel heat content (in Btu per physical unit)

Fuel Type	Fuel Heat Content	Units	Heat Rate	Units	Energy Generated	Units	Emissions	Units	Emissions	Units	Emissions	Units		
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	0.132080297	kWh / ft3								
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	0.004664376	kWh / liter								
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	4.664376052	kWh / m3	0.40411836	kg CO2 / kWh	3.60177E-05	kg CH4 / kWh	7.20354E-07	kg N2O / kWh	0.40531775	kg CO2e / kWh for typical natural gas feedstock
							404.1183599	kg CO2 / MWh	0.036017679	kg CH4 / MWh	0.000720354	kg N2O / MWh	405.317749	kg CO2e / MWh for typical natural gas feedstock
													1.16205126	Manual conversion factor to get to Total's requested Emissions Factor
							469.6062488	kg CO2 / MWh	0.041854389	kg CH4 / MWh	0.000837088	kg N2O / MWh	471	kg CO2e / MWh based on Total's Requested Emissions Factor

OTHER INPUTS

AGRU Acid Composition for Incinerator

Ref: BAT Study

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/hr)	CO2 Conversion After Combustion	Mass After Combusion	Mass % After Combustion
H2O	6.614%	1.191	2.825%	67.798	-	67.798	2.815%
Nitrogen	0.001%	0.000	0.001%	0.014	-	0.014	0.001%
Carbon Dioxide	92.912%	40.890	96.949%	2,326.770	2,326.770	2,340.689	97.184%
Methane	0.390%	0.063	0.148%	3.564	9.777	-	0.000%
Ethane	0.040%	0.012	0.028%	0.679	1.988	-	0.000%
Ethylene	0.000%	0.000	0.000%	-	-	-	0.000%
Propane	0.004%	0.002	0.004%	0.095	0.285	-	0.000%
i-Butane	0.000%	0.000	0.000%	0.010	0.030	-	0.000%
n-Butane	0.000%	0.000	0.000%	0.007	0.020	-	0.000%
i-Pentane	0.000%	0.000	0.000%	-	-	-	0.000%
n-Pentane	0.000%	0.000	0.000%	0.008	0.025	-	0.000%
Hexane	0.000%	0.000	0.000%	-	-	-	0.000%
Heptane	0.000%	0.000	0.000%	0.011	0.035	-	0.000%
Benzene	0.012%	0.009	0.022%	0.520	1.758	-	0.000%
H2S	0.027%	0.009	0.022%	0.524	-	-	0.000%
Total	**100.000%**	**42.18**	**100.000%**	**2,400.00**	**2,340.689**	**2,408.500**	**100.00%**

Moles	**g / mole**	*# Carbon*	*% Carbon*	*g Carbon*	*CO2 from Combustion (g / mol)*
H2O	18.02				
Nitrogen	28.01				
Carbon Dioxide	44.01	*1*			
Methane	16.04	*1*	*74.87%*	*12.01*	*44.01*
Ethane	30.07	*2*	*79.89%*	*24.02*	*88.02*
Ethylene	28.05	*2*	*85.64%*	*24.02*	*88.02*
Propane	44.10	*3*	*81.71%*	*36.03*	*132.03*
i-Butane	58.12	*4*	*82.66%*	*48.04*	*176.04*
n-Butane	58.12	*4*	*82.66%*	*48.04*	*176.04*
i-Pentane	72.15	*5*	*83.23%*	*60.05*	*220.05*
n-Pentane	72.15	*5*	*83.23%*	*60.05*	*220.05*
Hexane	86.18	*6*	*83.62%*	*72.06*	*264.06*
Heptane	100.21	*7*	*83.90%*	*84.07*	*308.07*
Benzene	78.11	*6*	*92.26%*	*72.06*	*264.06*
H2S	34.08	*5*	*1.762087716*	*60.0535*	
MDEA					
PIPERAZINE					
Total					**1.98**

NRU incinerator

Ref: Email from TotalEnergies

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/hr)
Nitrogen	99.90%	27.985	99.94%	4295.7
Methane	0.10%	0.016	0.06%	4.3
Total	**100.00%**	**28.001**	**100.00%**	**4300**

Flare Gas (Pilot)

Ref: Email from TotalEnergies

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/yr)
Nitrogen	19.56%	5.479	29.805%	33942.411
Methane	80.44%	12.905	70.195%	79937.589
Total	**100.00%**	**18.38**	**100.00%**	**113880.00**

Flare Gas (Other)

Ref: Email from TotalEnergies

Component	Composition (% mol)	mol C	Molar Mass	Mass %	Mass Flow Rate (kg/yr) (Initial Start-Up)	Molar Flow Rate (kmol/yr) (Initial Start-Up)	Mass Flow Rate (kg/yr) (Start-Up after Maintenance)	Molar Flow Rate (kg/yr) (Start-Up after Maintenance)	Mass Flow Rate (kg/yr) (Other Flaring)	Molar Flow Rate (kg/yr) (Other Flaring)
H2O	0.01%		0.002	0.01%	29.9	1.7	14.2	0.8	118.2	6.6
Nitrogen	4.88%		1.367	7.95%	22679.1	809.6	10746.6	383.6	89660.7	3200.6
Carbon Dioxide	0.65%		0.286	1.66%	4745.7	107.8	2248.8	51.1	18761.9	426.3
Methane	92.68%	0.927	14.868	86.45%	246658.9	15375.4	116880.3	7285.7	975154.9	60785.9
Ethane	1.15%	0.023	0.346	2.01%	5736.6	190.8	2718.3	90.4	22679.5	754.2
Ethylene	0.00%	0.000	0.000	0.00%	0.0	0.0	0.0	0.0	0.0	0.0
Propane	0.35%	0.011	0.154	0.90%	2560.6	58.1	1213.4	27.5	10123.3	229.6
i-Butane	0.09%	0.004	0.052	0.30%	867.8	14.9	411.2	7.1	3430.7	59.0
n-Butane	0.10%	0.004	0.058	0.34%	964.2	16.6	456.9	7.9	3811.9	65.6
i-Pentane	0.03%	0.002	0.022	0.13%	359.1	5.0	170.2	2.4	1419.6	19.7
n-Pentane	0.06%	0.003	0.043	0.25%	718.2	10.0	340.3	4.7	2839.3	39.4
Total	**100.00%**	**0.97**	**17.20**	**100%**	**285320**	**16590**	**135200**	**7861**	**1128000**	**65587**

GHG Emissions									
Construction Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
Construction Diesel Used	30,000.00	liters / day							
Resulting Emissions	81,734.40	kg CO2 / day	3.30	kg Ch4 / day	0.66	kg N2O / day			
Resulting Emissions	29,833,056.00	kg CO2 / year	1,203.49	kg CH4 / year	241.12	kg N2O / year			
Resulting Emissions	**29,833.06**	**tonnes CO2 / year**	**1.20**	**tonnes CH4 / year**	**0.24**	**tonnes N2O / year**	**29,932.46**	**tonnes CO2e / year**	
Annualised Emissions	**84,526.99**	**tonnes CO2 / construction lifetime of 34months**	**3.41**	**tonnes CH4 / construction lifetime of 34 months**	**0.68**	**tonnes N2O / construction lifetime of 34 months**	**84,808.64**	**tonnes CO2e / construction lifetime of 34 months**	
Scope 1 Operational Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
AGRU Emissions									
Emissions from Fuel Gas									
Incinerator Fuel Flow Rate (methane)	38.00	kg / hour							
Incinerator Fuel Flow Rate (methane)	0.04	tonne / hour							
Resulting Emissions	107.53	kg CO2 / hour	0.00	kg CH4 / hour	0.00	kg N2O / hour			Assumed 100% efficiency. No stated guidance in API Compendium
Resulting Emissions	2,580.66	kg CO2 / day	0.05	kg CH4 / day	0.00	kg N2O / day			
Resulting Emissions	941,939.57	kg CO2 / year	17.82	kg CH4 / year	0.00	kg N2O / year			
Resulting Emissions	**941.94**	**tonnes CO2 / year**	**0.02**	**tonnes CH4 / year**	**0.00**	**tonnes N2O / year**	**942.44**	**tonnes CO2e / year**	
Emissions from Direct CO2 Release									
Acid Gas Flow Rate	6,153.00	kg / hour							
Incinerator Acid Flow Rate	5,845.35	kg / hour							
CO2 Flow Rate (direct release)	5,666.99	kg CO2 / hour							
Resulting Emissions	136,007.84	kg CO2 / day							
Resulting Emissions	49,642,860.56	kg CO2 / year							
Resulting Emissions	**49,642.86**	**tonnes CO2 / year**					**49,642.86**	**tonnes CO2e / year**	
Emissions from Incineration									
Incineration Flow Rate	10.65	kg / hour						AGRU flowrate 6153 kg/hr from ESIA	
Incineration Flow Rate	0.01	tonne / hour							
Resulting Emissions	35.68	kg CO2 / hour	-	kg CH4 / hour	-	kg N2O / hour			Assumed 100% efficiency. No stated guidance in API Compendium
Resulting Emissions	856.42	kg CO2 / day	-	kg CH4 / day	-	kg N2O / day			
Resulting Emissions	312,593.83	kg CO2 / year	-	kg CH4 / year	-	kg N2O / year			
Resulting Emissions	**312.59**	**tonnes CO2 / year**	**-**	**tonnes CH4 / year**	**-**	**tonnes N2O / year**	**312.59**	**tonnes CO2e / year**	
Total Emissions from AGRU	**50,897.39**	**tonnes CO2 / year**	**0.02**	**tonnes CH4 / year**	**0.00**	**tonnes N2O / year**	**50,897.89**	**tonnes CO2e / year**	
NRU Emissions									
Emissions from Methane Incineration									
Methane Flow Rate			35,784.60	kg / year					95% Availability Factor applied to the CH4 flowrate, otherwise assumed operational at 24 hours per day, 365 days per year.
Resulting Emissions	97.68		0.18	tonnes CH4 / year	-	tonnes N2O / year	102.67	tonnes CO2e / year	Assumed 99.5% methane combustion
Total Emissions from NRU	**97.68**	**tonnes CO2 / year**	**0.18**	**tonnes CH4 / year**	**-**	**tonnes N2O / year**	**102.67**	**tonnes CO2e / year**	
Flaring Emissions									
Flare Pilot	108,186.00	kg / year							Availability Factor of 95% applied here.
Initial Start-Up	285,320.00	kg / year							
Start-up after Maintenance	135,200.00	kg / year							
Other Flaring (after trips, upsets, relief etc)	1,128,000.00	kg / year							
Total Flaring	1,656,706.00	kg / year							
Resulting Emissions Flare Pilot	214.91	tonnes CO2 / year	1.60	tonnes CH4 / year	0.00	tonnes N2O / year	**259.61**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Initial Start-Up	700.50	tonnes CO2 / year	4.93	tonnes CH4 / year	0.00	tonnes N2O / year	**838.47**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Start-up after Maintenance	331.94	tonnes CO2 / year	2.34	tonnes CH4 / year	0.00	tonnes N2O / year	**397.31**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Resulting Emissions Other Flaring (after trips, upsets, relief etc)	2,769.40	tonnes CO2 / year	19.50	tonnes CH4 / year	0.00	tonnes N2O / year	**3,314.86**	**tonnes CO2e / year**	Assuming 98% combustion efficiency, API (2021)
Total Emissions from Flaring	**4,016.75**	**tonnes CO2 / year**	**28.37**	**tonnes CH4 / year**	**0.01**	**tonnes N2O / year**	**4,810.25**	**tonnes CO2e / year**	
Scope 2 Operational Emissions	**CO2 Emissions**	**Units**	**CH4 Emissions**	**Units**	**N2O Emissions**	**Units**	**CO2e Emissions**	**Units**	**References**
Electricity-Related Emissions									
Emissions from Production							244,167.48	tonnes CO2e / year	
Emissions from Offices							16,277.83	tonnes CO2e / year	
Total Emissions from Electricity Consumption							**260,445.31**	**tonnes CO2e / year**	
Emissions Summary									
Scope 1 Emissions During Operations (Without Flaring)	50,995.07	tonnes CO2 / year	0.20	tonnes CH4 / year	0.00	tonnes N2O / year	51,000.56	tonnes CO2e / year	
Scope 1 Emissions During Operations (With Flaring)	55,011.82	tonnes CO2 / year	28.57	tonnes CH4 / year	0.01	tonnes N2O / year	55,810.81	tonnes CO2e / year	
Lifetime Scope 1 Emissions During Operations (Without Flaring)	1,274,876.79	tonnes CO2 / project lifetime of 25 years	4.92	tonnes CH4 / project lifetime of 25 years	0.00	tonnes N2O / project lifetime of 25 years	1,275,014.03	tonnes CO2e / project lifetime of 25 years	
Lifetime Scope 1 Emissions During Operations (With Flaring)	1,375,295.53	tonnes CO2 / project lifetime of 25 years	714.23	tonnes CH4 / project lifetime of 25 years	0.17	tonnes N2O / project lifetime of 25 years	1,395,270.32	tonnes CO2e / project lifetime of 25 years	
Total (with flaring at start-up)	52,027.51	tonnes CO2 / year	7.47	tonnes CH4 / year	0.00	tonnes N2O / year	52,236.34	tonnes CO2e / year	
Scope 2 Emissions During Operations without Solar Plant							260,445.31	tonnes CO2e / year	
Lifetime Scope 2 Emissions During Operations							6,511,132.80	tonnes CO2e / project lifetime of 25 years	
Scope 2 Emissions During Operations with Solar Plant							**0.00**	**tonnes CO2e / year**	
Total Emissions During Operations without Solar Plant (Without Flaring)							311,445.87	tonnes CO2e / year	
Total Emissions During Operations without Solar Plant (With Flaring)							316,256.12	tonnes CO2e / year	
Total Emissions During Operations with Solar Plant (Without Flaring)							**51,000.56**	**tonnes CO2e / year**	
Total Emissions During Operations with Solar Plant (With Flaring)							**55,810.81**	**tonnes CO2e / year**	
Lifetime Emissions During Operations without Solar Plant (Without Flaring)							7,786,146.83	tonnes CO2e / project lifetime of 25 years	
Lifetime Emissions During Operations without Solar Plant (With Flaring)							7,906,403.12	tonnes CO2e / project lifetime of 25 years	
Lifetime Emissions During Operations with Solar Plant (Without Flaring)							**1,275,014.03**	**tonnes CO2e / project lifetime of 25 years**	
Lifetime Emissions During Operations with Solar Plant (With Flaring)							**1,395,270.32**	**tonnes CO2e / project lifetime of 25 years**	

Energy				
Construction			Percentages	**Notes**
Diesel Consumption	30,000.00	liters / day		
Diesel Consumption	10,950,000.00	liters / year		
Diesel Consumption	27,375,000.00	liters / construction period of 30 months		
Operations				
AGRU Incinerator Fuel Flow Rate	40.00	kg / hour		
AGRU Incinerator Fuel Flow Rate	350,400.00	kg / year	17.4%	
AGRU Incinerator Fuel Flow Rate	8,760,000.00	kg / project lifetime of 25-years		
Flare Pilot	13.00	kg / hour		Continuous routine flaring
Flare Pilot	113,880.00	kg / year	5.7%	
Flare Pilot	2,847,000.00	kg / project lifetime of 25-years		
	781.70	kg / hour		
Initial Start-Up	285,320.00	kg / year	14.2%	
Initial Start-Up	7,133,000.00	kg / project lifetime of 25-years		
	370.41	kg / hour		
Start-up after Maintenance	135,200.00	kg / year	6.7%	
Start-up after Maintenance	3,380,000.00	kg / project lifetime of 25-years		
	3,090.41	kg / hour		
Other Flaring (after trips, upsets, relief etc)	1,128,000.00	kg / year	56.0%	
Other Flaring (after trips, upsets, relief etc)	28,200,000.00	kg / project lifetime of 25-years		
Annual Energy Consumption During Operation (Without Flaring)	350,400.00	kg / year		
Energy Consumption During Entire Project Lifetime of 25-Years (Without Flaring)	8,760,000.00	kg / project lifetime of 25-years		
Annual Energy Consumption During Operation (With Flaring)	2,012,800.00	kg / year		
Energy Consumption During Entire Project Lifetime of 25-Years (With Flaring)	50,320,000.00	kg / project lifetime of 25-years		

Energy					
Operations	Usage	Usage (incl availability)	Units	Percentages	**Notes**
Offices, Warehouses, Accomodations: Air Conditioning / Ventilation	29784000	28,294,800.00	kWh	4.250%	Updated assumptions from Total that buildings will use 5 MWe of power on average. TPC/ERM notes that this seems high, and actually it is not higher than our previous model presented in version 1.6 of the Excel. In version 1.6, Total also said the value it already high, but Total has now requested the value to be even higher. So, there might be some confusion here. TPC/ERM's further extrapolation that, of this we can assume 68% is for cooling, 12% is for lighting, 10% is for computers/appliances, 5% Water Heating, and 5% other. A 95% availability factor is applied, and consumption is annualized at 24 hours per day, 365 days per year of electricity consumption.
Offices, Warehouses, Accomodations: Lighting	5256000	4,993,200.00	kWh	0.750%	
Offices, Warehouses, Accomodations: Computers/Office Equipment / Appliances	4380000	4,161,000.00	kWh	0.625%	
Offices, Warehouses, Accomodations: Hot Water	2190000	2,080,500.00	kWh	0.313%	
Offices, Warehouses, Accomodations: Other	2190000	2,080,500.00	kWh	0.313%	
Production: Compressors and Other	657000000	624,150,000.00	kWh	93.750%	Compressors for the LNG Train. The power profile is set at 76 Mwe for the plant processes as was defined by Total during the GHG review process. A 95% availability factor is applied, and consumption is annualized at 24 hours per day, 365 days per year of electricity consumption.
Backup Generators	N/A	N/A	N/A	N/A	No information is known on the potential consumption of diesel for the backup generator, however it is expected that this will be negligible in terms of both total energy consumed and resulting GHG emissions for the project
Total	**700,800,000.00**	**665,760,000.00**	kWh	100.000%	

GWPs	(IPCC AR6)
GHG	GWP values for 100-year time horizon
CO_2	1
CH_4	27.9
N_2O	273

Densities and HHV					
	HHV	Units	Density	Units	Reference
Diesel	0.0387	TJ / m3 diesel			API 2021
NG (AGRU)	38	MJ / m3 NG	0.6728	kg / m3	ISO 6976
Acid gas (AGRU)		MJ / m3 acid gas		kg / m3	ISO 6976
Flare gas (Pilot)	27.31	MJ / m3 flare gas	0.7775	kg / m3	ISO 6976
Flare gas (Others)	32.8	MJ / m3 flare gas	0.7273	kg / m3	ISO 6976

Emission Factors	CO2	Units		CH4	Units		N2O	Units
Construction EF	Diesel Stationary (API 2021)							
Emission factor (CO2)	70.4	tonnes / TJ diesel	Emission factor (CH4)	0.0028	tonnes / TJ diesel	Emission factor (N2O)	0.0006	tonnes / TJ diesel
Emission factor (CO2)	2.72	kg CO2 / litre diesel	Diesel emission factor (CH4)	0.0001	kg CH4 / tonne fuel	Diesel emission factor (N2O)	2.20E-05	kg N2O / tonne fuel
AGRU EF	NG Stationary (API 2021)							
Emission factor (CO2)	50.10	tonnes CO2 / TJ NG	Emission factor (CH4)	0.0009	tonnes CH4 / TJ NG	Emission factor (N2O)	9.48E-05	tonnes / TJ NG
NG emission factor (CO2)	2,830	kg CO2 / tonne NG	NG emission factor (CH4)	0.0535	kg CH4 / tonne NG	NG emission factor (N2O)	5.35E-06	kg N2O / tonne NG
Emission factor (CO2)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (CH4)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (N2O)	No published N2O emission factors for thermal oxidiser (API 2021)	
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)		
AGRU EF								
Emission factor (CO2)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (CH4)	Calculated on composition basis. See "Other Inputs" tab		Emission factor (N2O)	No published N2O emission factors for thermal oxidiser (API 2021)	
Incineration emission factor (CO2)			Incineration emission factor (CH4)			Incineration emission factor (N2O)		
Flaring EF							(API 2021)	
Flare Pilot EF (CO2)	Calculated on composition basis. See "Other Inputs" tab		Flare Pilot EF (CH4)	Calculated on composition basis. See "Other Inputs" tab		Flare Pilot EF (N2O)	3.33E-06	EF (kg N2O / kg flare gas)
Initial Start-Up EF (CO2)			Initial Start-Up EF (CH4)			Initial Start-Up EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Start-up after Maintenance EF (CO2)			Start-up after Maintenance EF (CH4)			Start-up after Maintenance EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)
Other Flaring EF (CO2)			Other Flaring EF (CH4)			Other Flaring EF (N2O)	4.28E-06	EF (kg N2O / kg flare gas)

Electricity Grid Factor	IEA (2022)	
Oman emission factor (CO2e)	[redacted]	gCO2/kWh
Solar emission factor (CO2e)	[redacted]	gCO2/kWh

Due to licensing agreements by IEA with ERM, the factors cannot be shared with anyone outside of Total's business (apart from auditors), and cannot be disclosed in the public domain. Total can state that IEA emissions factors were used, but is not permitted to provide the value of X gCO2e/kwh

Total's Suggested EF for Electricity

Amount of fuel used per kWh = Heat rate (in British Thermal Units (Btu) per kWh) / Fuel heat content (in Btu per physical unit)

Fuel Type	Fuel Heat Content	Units	Heat Rate	Units	Energy Generated	Units	Emissions	Units	Emissions	Units	Emissions	Units		
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	0.132080297	kWh / ft3								
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	0.004664376	kWh / liter								
Natural Gas (2018)	1033	Btu / ft3	7821	Btu / kWh	4.664376052	kWh / m3	0.40411836	kg CO2 / kWh	3.60177E-05	kg CH4 / kWh	7.20354E-07	kg N2O / kWh	0.40531775	kg CO2e / kWh for typical natural gas feedstock
							404.1183599	kg CO2 / MWh	0.036017679	kg CH4 / MWh	0.000720354	kg N2O / MWh	405.317749	kg CO2e / MWh for typical natural gas feedstock
													1.16205126	Manual conversion factor to get to Total's requested Emissions Factor
							469.6062488	kg CO2 / MWh	0.041854389	kg CH4 / MWh	0.000837088	kg N2O / MWh	471	kg CO2e / MWh based on Total's Requested Emissions Factor

OTHER INPUTS

AGRU Acid Composition for Incinerator

Ref: BAT Study

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/hr)	CO2 Conversion After Combustion	Mass After Combustion	Mass % After Combustion
H2O	6.614%	1.191	2.825%	173.816	-	173.816	2.815%
Nitrogen	0.001%	0.000	0.001%	0.037	-	0.037	0.001%
Carbon Dioxide	92.912%	40.890	96.949%	5,965.256	5,965.256	6,000.940	97.184%
Methane	0.390%	0.063	0.148%	9.137	25.065	-	0.000%
Ethane	0.040%	0.012	0.028%	1.741	5.098	-	0.000%
Ethylene	0.000%	0.000	0.000%	-	-	-	0.000%
Propane	0.004%	0.002	0.004%	0.244	0.732	-	0.000%
i-Butane	0.000%	0.000	0.000%	0.025	0.077	-	0.000%
n-Butane	0.000%	0.000	0.000%	0.017	0.051	-	0.000%
i-Pentane	0.000%	0.000	0.000%	-	-	-	0.000%
n-Pentane	0.000%	0.000	0.000%	0.021	0.064	-	0.000%
Hexane	0.000%	0.000	0.000%	-	-	-	0.000%
Heptane	0.000%	0.000	0.000%	0.029	0.090	-	0.000%
Benzene	0.012%	0.009	0.022%	1.333	4.507	-	0.000%
H2S	0.027%	0.009	0.022%	1.342	-	-	0.000%
Total	**100.000%**	**42.18**	**100.000%**	**6,153.00**	**6,000.940**	**6,174.793**	**100.00%**

Moles	g / mole	*# Carbon*	*% Carbon*	*g Carbon*	*CO2 from Combustion (g / mol)*
H2O	18.02				
Nitrogen	28.01				
Carbon Dioxide	44.01	*1*			
Methane	16.04	*1*	*74.87%*	*12.01*	*44.01*
Ethane	30.07	*2*	*79.89%*	*24.02*	*88.02*
Ethylene	28.05	*2*	*85.64%*	*24.02*	*88.02*
Propane	44.10	*3*	*81.71%*	*36.03*	*132.03*
i-Butane	58.12	*4*	*82.66%*	*48.04*	*176.04*
n-Butane	58.12	*4*	*82.66%*	*48.04*	*176.04*
i-Pentane	72.15	*5*	*83.23%*	*60.05*	*220.05*
n-Pentane	72.15	*5*	*83.23%*	*60.05*	*220.05*
Hexane	86.18	*6*	*83.62%*	*72.06*	*264.06*
Heptane	100.21	*7*	*83.90%*	*84.07*	*308.07*
Benzene	78.11	*6*	*92.26%*	*72.06*	*264.06*
H2S	34.08	*5*	*1.762087716*	*60.0535*	
MDEA					
PIPERAZINE					
Total					**1.98**

NRU incinerator

Ref: Email from TotalEnergies

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/hr)
Nitrogen	99.90%	27.985	99.94%	4295.7
Methane	0.10%	0.016	0.06%	4.3
Total	**100.00%**	**28.001**	**100.00%**	**4300**

Flare Gas (Pilot)

Ref: Email from TotalEnergies

Component	Composition (% mol)	Molar Mass	Mass %	Mass Flow Rate (kg/yr)
Nitrogen	19.56%	5.479	29.805%	33942.411
Methane	80.44%	12.905	70.195%	79937.589
Total	**100.00%**	**18.38**	**100.00%**	**113880.00**

Flare Gas (Other)

Ref: Email from TotalEnergies

Component	Composition (% mol)	mol C	Molar Mass	Mass %	Mass Flow Rate (kg/yr) (SU Flaring Warm)	Molar Flow Rate (kmol/yr) (SU Flaring Warm)	Mass Flow Rate (kg/yr) (SU Flaring Liquefaction (Cold Section))	Molar Flow Rate (kg/yr) (SU Flaring Liquefaction (Cold Section))	Mass Flow Rate (kg/yr) (SU Flaring EFG/NRU (Cold Section))	Molar Flow Rate (kg/yr) (SU Flaring EFG/NRU (Cold Section))
H2O	0.01%		0.002	0.01%	29.9	1.7	14.2	0.8	118.2	6.6
Nitrogen	4.88%		1.367	7.95%	22679.1	809.6	10746.6	383.6	89660.7	3200.6
Carbon Dioxide	0.65%		0.286	1.66%	4745.7	107.8	2248.8	51.1	18761.9	426.3
Methane	92.68%	0.927	14.868	86.45%	246658.9	15375.4	116880.3	7285.7	975154.9	60785.9
Ethane	1.15%	0.023	0.346	2.01%	5736.6	190.8	2718.3	90.4	22679.5	754.2
Ethylene	0.00%	0.000	0.000	0.00%	0.0	0.0	0.0	0.0	0.0	0.0
Propane	0.35%	0.011	0.154	0.90%	2560.6	58.1	1213.4	27.5	10123.3	229.6
i-Butane	0.09%	0.004	0.052	0.30%	867.8	14.9	411.2	7.1	3430.7	59.0
n-Butane	0.10%	0.004	0.058	0.34%	964.2	16.6	456.9	7.9	3811.9	65.6
i-Pentane	0.03%	0.002	0.022	0.13%	359.1	5.0	170.2	2.4	1419.6	19.7
n-Pentane	0.06%	0.003	0.043	0.25%	718.2	10.0	340.3	4.7	2839.3	39.4
Total	**100.00%**	**0.97**	**17.20**	**100%**	**285320**	**16590**	**135200**	**7861**	**1128000**	**65587**

ANNEX 3: GHG MITIGATION MEASURES

GHG MITIGATION MEASURES

The Guidelines for the Preparation of Climate Affairs Chapter in the EIA Study for the projects (2013) requires options to reduce greenhouse gas (GHG) emissions to be identified and introduced during the EIA process as part of climate affairs mitigation.

Initiatives proposed for the reduction of GHG emissions for the Marsa LNG development were assessed and summarised by TotalEnergies in the document "*SOH-00000-TOTA-TOTA-MEM-00022 Marsa LNG Project – CFR initiatives – GHG minimization implementation*" (referred to as GHG Minimisation Memo) prepared on 24/08/2023. This GHG Minimisation Memo is an executive summary of a more detailed document prepared by TotalEnergies; therefore, details on the technical and financial feasibility have not been included in this annex.

The GHG Minimisation Memo has identified numerous opportunities to reduce emissions. The emission reduction opportunities identified cover a large breadth of options from alternative electricity sources to flaring reduction initiatives and technology selection.

It has been noted that the plant is mostly electrically driven therefore, when compared to analogous projects, Marsa LNG has fewer combustion sources and different opportunities for reducing Scope 1 emissions.

A Best Available Techniques (BAT) Assessment was also conducted for the Marsa LNG development, independently of the GHG Minimisation Memo.

The summary of mitigation measures is shown in Table 1.

Table 1 Summary of Emission Reduction Initiatives Considered for Marsa LNG as Documented in the GHG Minimisation Memo

GHG reduction initiative	Technical feasibility	Financial feasibility	Emission reduction potential	Outcome
Native CO_2[1] Emissions estimated to be 19.3 ktCO_2e/yr following native CO_2 initiatives				
Solar plant providing green electricity	Not assessed by ERM	Not assessed by ERM	All Scope 2 emissions	The plant is mostly electrically driven with fuel gas used for the AGRU and pilot flare, only. It is expected that the solar plant will produce electrical power in excess of the LNG plant consumption however there is currently limited technical data as the plant is still under negotiation.
CO_2 reinjection	Not considered technically feasible as there is not a CO_2 network pipeline or CO_2 storage reservoir in the vicinity of Sohar	n/a	Not quantified by ERM	Not implemented
CO_2 valorisation	CO_2 valorisation not considered within the core expertise of TotalEnergies	Uncertainty in local market demand for food grade CO_2. No other commercially viable valorisation options were identified	Not quantified by ERM	Not implemented
Furnace electrification	Four options have been considered and discussed with the suppliers of electrical heaters:	Not assessed by TotalEnergies	Not quantified by ERM	Electrical heating will be implemented, where the MV electrical heater and electrical boiler options have been considered for implementation. The Tenderers will

[1] The native CO_2 in Marsa LNG comes from the CO_2 contained in the feed gas to the facility.

GHG reduction initiative	Technical feasibility	Financial feasibility	Emission reduction potential	Outcome
	■ Direct replacement of each individual process HTF heater with individual electrical heaters. ■ Low Voltage Electrical Heater ■ Medium Voltage Electrical Heater ■ Electrical Boiler			make their own assessment and selection.
Flaring reduction Emissions estimated to be 4.4 ktCO_2e/yr following implementation of flaring reduction initiatives				
Flare design Four flare systems provided: ■ Wet flare (HP) ■ Dry flare (HP) ■ Common spare flare for wet and dry flares ■ BOG flare (LP) for LNG tank and ship Facility has been designed to be a zero-flaring plant where all normal flaring base line emitters (flare header purging, compressor seal gas vents) have been eliminated.	Not assessed by ERM	Not assessed by ERM	Not quantified by ERM	The following flaring activities will take place: ■ Flare pilot ■ Flaring at initial start-up ■ Flaring at start-up after maintenance ■ Other flaring e.g., after trips, upsets, relief etc.
Initial start-up flaring Starting up facility and performing defrosting operations using nitrogen as opposed to natural gas to reduce flaring of natural gas	Not assessed by ERM	In discussion with Halliburton	In discussion with Halliburton	Start-up using nitrogen is considered to be the base case start-up methodology for Marsa LNG. Details in discussion with Halliburton
Seal gas of compressors Seal gas for major compressors will be recovered to ensure zero-flaring	Not assessed by ERM	Not assessed by ERM	Not quantified by ERM	Seal gas recovery will be implemented however details not provided for technical and financial feasibility or the expected emission reduction potential.

GHG reduction initiative	Technical feasibility	Financial feasibility	Emission reduction potential	Outcome
Passing valves	Routine flaring, safety flaring of purge gas and non-routine flaring have been eliminated through design however it has not been possible to eliminate emissions from passing valves ■ Best-in-class valve design selected for the project, ■ Latest guidance on passing valve identification/ repair will be applied. Routine monitoring campaign using the proposed tool have demonstrated good performance on other plants and will be implemented on Marsa to ensure passing valves are identified, ■ It is considered that the identified passing valves can be repaired promptly online under temporary operating procedures.	Not assessed by ERM	Not quantified by ERM	Passing valves best practice is technically feasible however emissions reduction potential has not been quantified.
Closed flare Deployment of a closed flare system to eliminate small amounts of gas that may be flared	Not assessed by ERM	Not considered cost effective	Not quantified by ERM	Not implemented
Methane venting Emissions estimated to be 0.1 ktCO_2e/yr following elimination of NRU venting				
Methane venting elimination To comply with company policies focused on eliminating the venting of methane, residual methane in vented nitrogen from the NRU will be combusted using a regenerative thermal oxidiser (RTO) to convert the methane to CO_2	Four potential technologies were considered for the removal of excess nitrogen where cryogenic nitrogen removal was selected. This process is able to reduce methane content in the nitrogen to 1000 ppm(v) which is the best available technology in the LNG industry	Not assessed by ERM	1.1 ktCO_2e/yr	Technical feasibility has been assessed for the NRU in the BAT. It is planned to be implemented however the cost of installing and running an RTO vs the marginal reduction in annual emissions has not been assessed.

GHG reduction initiative	Technical feasibility	Financial feasibility	Emission reduction potential	Outcome
	This has been coupled with an RTO to minimise methane venting however it is not clear if other technologies were also considered			
MR composition adjustment/recovery of MCHE leaks				
MR refrigerant composition adjustment valves are not routed to flare but back to the process (LNG) to minimize flaring. This arrangement will also prevent flaring in case MCHE leaks develop in the future. The leaked NG/MR will be recovered instead of being sent to flare.	Not assessed by ERM	Not assessed by ERM	Not quantified by ERM	Details not provided for technical and financial feasibility or the expected emission reduction potential.
Note: information in this table is as stated by TotalEnergies in the GHG Minimisation Memo.				

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APPENDIX E RESPONSES TO SIPC COMMENTS SCOPING REPORT

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
1.General Remarks	**1.1**	The scoping report is very much focused on the IFC standards and does not reflect that the same EIA will be the permit application as well for the project.	The **ESIA** will meet MECA standards as well as IFC standards, with the more detailed information required by IFC being placed in an Appendix. It is our deliberate intention to ensure that a single ESIA report is compliant with both sets of requirements in order that only one ESIA document serves as the master document for the project as it progresses.	ESIA addresses the Omani regulatory framework, EA and SIPC standards as well as IFC (Section 2)
	1.2	It is advised to assure that an integral approach will result in an aligned safety design for liquefaction and jetty facilities and those operations are well coordinated.	**Safety:** TOTAL confirms that the different facilities of the plant (jetty head, trestle, LNG plant, LNG storage tank, etc.) are assessed and designed with respect to safety and risks as part of an integral approach. Reference is made to the project Safety Concept. **ESIA:** The ESIA will include commitment/statement that TOTAL will ensure that requirements will be complied (in PD and ESMP)	Included in ESIA as part of Section 3.9 in the Project Description.
	1.3	It important to highlight that the statement in the scoping report that BAT-compliance is not required is not accepted. In order to assure that BAT approach is used, the EIA must include a BAT-compliance study that includes the BAT-conclusions that are followed and explanation if an alternative is used with proof of equivalence. The project have to comply with IPPC and all applicable BREFS documents.	See further details in **aspect 4 - BAT**. Considering the project characteristics, the site does not fall under the IED requirements. However, in alignment with national requirements and international practice, the project will apply general BAT (e.g. implementation of an environmental management system, monitoring, energy efficiency measures etc.) which will be qualitatively described in the ESIA.	Described in ESIA in Section 2.5
	1.4	For baseline study, it is advised to complete it with support and close coordination with MECA and SIPC.	Noted. We understand that this requirement relates to the noise baseline survey described in the ESIA (to be undertaken by 5OES), and when the land is constructed that any additional studies led by TOTAL (e.g. zero soil survey) will be carried out when the reclamation is complete under the post-ESIA ESAP process.	Noise baseline survey results described in the ESIA. It is our understanding that the pre-development soil condition will be provided by SIPC verified through a zero soil analysis. A zero-soil survey (as per SIPC requirements) is proposed as a mitigation measures at the decommissioning phase to assess difference in potential

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
				contamination levels in the soil.
	1.5	Provide clearer master layout and legend indicating assets with numbering.	Due to the fact that the Project is at the FEED stage with three competing FEED contractors, TOTAL suggests to present the master layout from all three FEED contractors as alternatives to be assessed from an environment and social perspective, with the final layout to be selected in due course.	
	1.6	**Permitting Formalities** It should be noted that the EIA is only part of the MECA permit application documentation. In addition, the permit application documentation is considered as part of the issued permit. This implies that the permit allows only activities, capacities, substances, emissions, etc. that are explicitly mentioned in the permit conditions or are in the permit application documents. SIPC requested to have the Quantitative Risk Assessment (QRA) and Safety Report as part of the HSSE requirements to approve the project (refer to Industrial Safety section below). The studies should be submitted by TOTAL as part of the formal application documentation. Since the permit process in Oman and in the SIPC industrial estate does rely on the EIA as main document for the permit application, it is advised to include in the EIA in depth information on the technical aspects of the project. This would include mass balances, energy aspects etc. design basis of equipment, emission source listing, dispersion calculations, foreseen monitoring etc. The location of the project on reclaimed land requires a coordinated approach with respect to the EIA and/or permit for the land reclamation. It is advised to assure that stakeholders (lenders) are satisfied with the permit situation and environmental impact assessment of the reclaimed land.	**Safety:** QRA will be part of the MECA permitting process. **Seveso**: The principle of Seveso III is understood and COMPANY kindly requests equivalent Seveso III dossier to understand the format and content requirements. **ESIA**: With respects to approval of lenders on the reclaimed land: The reclaimed land is NOT an associated facility since it not solely built for TOTAL and will accommodate multiple petrochemical industries. The jetty is recognized as an associated facility and included in the ESIA, making reference to the reclamation ESIA.	Project components and associated facilities are described in Section 3.3 of the ESIA. Reference to the reclamation ESIA has been included where relevant.

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
2. Project approach	**2.1**	The scoping report is concerned with the LNG liquefaction and storage activities. This means that construction and operation of the jetty and maritime part of bunkering are excluded. This has a risk that especially safety aspects are not integrally studied and coordinated for as well construction (design specifications, operations and safety/emergency aspects. The 'Guidance on LNG Bunkering' issued by EMSA ((European Maritime Safety Agency) contains useful background in general but also for also the Port Authorities . In the scoping study presented by the company, it is not visible in how far an integral approach to the project is taken.	**Safety:** From safety risk and safety design perspective, it is confirmed that the whole LNG installation (LNG plant, LNG storage tank, jetty head, trestle, etc.) form an integral system. **ESIA:** The construction of the topside and the operation of the jetty topside as well as marine bunkering operations are included in the scope of the ESIA. The construction of the sub-sea jetty components and mooring operation are outside the scope of the ESIA. The assessments of the subsea-construction of the jetty has been assessed in the reclamation ESIA, and this assessment will be taken into consideration in the present ESIA for the LNG plant.	The impacts related to the construction of the topside and the operation of the jetty topside as well as marine bunkering operations have been considered in the ESIA. Table 8.14 of the ESIA in Section 8.4 indicates the items that have been scoped out of the ESIA.
3. Report Quality	**3.1**	■ Seveso II is repeatedly used, Seveso III reference should be used. ■ Box 3.1 should be Box 2.2. ■ Multiple-+ Error! Reference source not found.	Accepted – will be corrected for the ESIA.	Taken into account throughout the ESIA (Seveso III and cross references).

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
4. BAT compliance	**4.1**	In chapter 2.2 is stated that the project does not fall under the application of the IED. However this is found disputable since gas refining is mentioned in the IED annex 1 1.2 'Refining mineral oil and gas'.	The type of installation fall in theory under IED Application: *1.4. Gasification or liquefaction of: (a) coal; (b) other fuels in installations with a total rated thermal input of 20 MW or more.* This, based on the information provided by Total, is not the Sohar case as the combustion thermal input of the equipment will not exceed the 20MW threshold, so the application of the IED is not required. The requirement for a BAT compliance study as found in the IPPC/IED regulation, due to the above, is not considered a regulatory requirement for this project. However, in alignment with national requirements and international practice, the project will apply general BAT (e.g. implementation of an environmental management system, monitoring, energy efficiency measures etc.) which will be qualitatively described in the ESIA.	Described in ESIA in Section 2.5
	4.2	In the EIA there must be a clear overview of the used design standards (e.g. EEMUA,NFPA, EPA,...) that are used for design of main equipment including but not limited to: • NG processing train • LNG Storage tanks • Flare • Safety and emergency response	**Safety:** In addition to TOTAL General Specifications that form a complete design corpus of documents, the following codes/ standards are used by the tenderers (list not exhaustive): • NG liquefaction train: no single specific standard to be mentioned but reference is made to API 2510 (LPG), API 560/NFPA 85 (fired heaters), EN 1473/NFPA 59A (LNG plant), SIGTTO (LNG transfer), • LNG storage tank: EN 14620 • Flares: API 520/521 • Safety: design follows NFPA standards as a minimum (mainly NFPA 10, 11, 15, 20, 22, 24, 25, 2001), API 2218 (fireproofing), EI 15/API 505/NFPA 497 (area classification) • Security: IMO ISPS	
	4.3	The scoping report refers to Seveso II and III and BAT and concludes that compliance with BAT is not required. The BREF 'Emissions from Storage' chapter 5 describes requirements for storage of liquefied gasses and emergency response. The BAT-conclusions for a natural gas refinery are related to the BREF 'Refining of Mineral Oil and Gas'.	See previous response regarding BAT compliance.	Described in ESIA in Section 2.5

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
5. Industrial Safety	**5.1**	The project has to comply with principles of Seveso III and as part of the permit application a Quantitative Risk Assessment (QRA) and Safety Report I Safety Case have to be prepared by an expert company in this field using industries standards. Project risks to be assessed as per UK HSE land use planning methodology. The Safety Report / Safety Case shall include a description of the Companies Safety Management System as well as the Emergency Response Planning. Considering the nature of LNG, it is of importance that it is described how the company will ensure that emergency response (include LNG spillage) is on an acceptable level and what kind of facilities (on-site, jetties, nearshore and off-site) they require as part of adequate emergency response. §	**Safety:** There is currently no plan for FEED to issue a Safety Report following the framework of SEVESO/ UK HSE Case and associated report content requirements. However, the key elements to be contained in such report will be produced by the end of FEED (end March), including QRA for the LNG Plant (with ALARP demonstration and major risk register). **Seveso**: COMPANY kindly requests equivalent Seveso III dossier to understand the format and content requirements.	
6. Flooding	**6.1**	Flooding cannot be scoped out due to the proximity to the sea. SIPC will provide the plot and the jetty with a certain agreed height and (shore) protection safety level (details available with Total). As part of the EIA it has to be assessed whether this provides enough safety level with regards to e.g. sea level rise, cyclones and associated extreme sea conditions, earthquakes and associated tsunamis as well as flooding due to extreme rainfall. It has to be evaluated to what extent the Total facility design and operations takes this in consideration and whether any mitigation measures are required. SIPC can provide support if required by provision of available studies (partly already available with Total).	**Drainage design is aligned with scenario provided by SIPC. Please kindly provide information on what has been done by other tenants in SIPC area.**	Note that flooding impacts have been considered as part of the ESIA's baseline in section 4.1.1.1 of the ESIA, section 4.1.4, in impacts related to groundwater and surface water (section 8.6.4 and 8.6.5) and in the Climate Affairs Study (Appendix D of the ESIA), considering the available information.

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
7. Other Issues	**7.1**	**Technical information** Not enough technical information were given in the scoping report. Please give a detailed project description in the EIA report that detailed main process lines and associated units with flowcharts and mass balances when applicable. This can result in EIA update in later stage if a major change in the design that might result in the major change in the environmental impact.	**ESIA**: We have three different designs/flowchart/mass balance and none of them can be selected as the most restrictive. Please specify which data is needed specifically for MECA permitting. **SIPC**: Please specify which data is required for SIPC needs.	Available information regarding the project description has been included in Section 3 of the ESIA. In the event that a change occurs in the project description, MARSA LNG LCC will implement a clear and transparent management of change according to Management of Change procedure (as explained in section 9.1.4 of the ESIA).
	7.2	**Environmental issues** The scoping report does not present details on environmental issues, but in the EIA they are expected. Some of the main environmental issues to be considered are: Waste management in general (Handling mercury containing waste, storage and disposal) Measures taken to minimize flaring. Measures taken to minimize the CH4 emission Techniques will be incorporated into the project's design to reduce Air emissions	All these aspects will be included in the ESIA. Measures taken to minimize flaring/CH4 emissions are related to design elements that will be implemented to reduce emissions, and these will be described in the ESIA.	In sections 8.6, 8.7, 8.8, 8.9, 8.10, 8.11, the environmental and social aspects potentially impacted by the project and the mitigation measures proposed are included. These include measures to reduce air emissions. The Climate affairs section, in Appendix D, also assesses in detail the air emissions considering the available project data information.
	7.3	■ In this review, suggestions for detailed studies are included however, these suggestions might already be planned by the consultant team for the EIA. ■ Administrative framework and regulations: should present only the applicable for the project and highlight the area of the applicability.	Noted.	

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
	7.4	■ The EIA study needs to dedicate a chapter to report the project's analysis of alternatives and outline the methodology implemented to attain results in the scoping report in terms of, but not limited to: - Process technologies - Abatement techniques - Operation of optimization - PFS and P&ID, mass balances, design basis ■ Environmental Management Plan (include "but limited to") - Monitoring Plan (Air, water, land, marine etc.), - Waste management plan, - Water and wastewater management plan (incl wwtp, first flush, firefighting water), - Energy control plan.	**ESIA**: The ESIA will include available information on alternatives. The ESIA will define that these plans will exist and will highlight the contents (framework). We have three different designs/flowchart/mass balance and none of them can be selected as the most restrictive. Please specify which data is needed specifically for MECA permitting. **SIPC**: Please specify which data is required for SIPC needs.	In section 3.10 the project alternatives are described based on the available project data information: location alternatives, technology and process alternatives, and no-project alternative. In Section 9.5, the specific management plans and procedures proposed are described.
	7.5	More focus on the main environmental issue	Noted.	
	7.6	Fugitive emission from Tank, loading, unloading, and vapour recovery managements. It also include the LDAR (Leak Detection & Repair) campaigns.	The ESIA will confirm that TOTAL has a fugitive management system in place.	Included as part of the mitigation measures proposed to mitigate AQ emissions-related impacts in Section 8.6.1 of the ESIA.
	7.7	Tools/methodology/approach that shall be used for the Air impact assessment was not mentioned in the scoping.	ERM issued a guidance and shared with TOTAL and SIPC.	
	7.8	All the water streams sources, uses in process, and final destination. This includes the hydro test water disposal.	Yes this will be considered, based on information available and reasonable assumptions were data is not available.	Considered based on project data information available in section 3.7.5.
	7.9	The EIA should study the possibly (in case needed) impact due soil improvements, depending on the quality of the reclaimed material. As additional soil dumping sites outside SIPA should be to approved by MECA.	**ESIA**: The ESIA will include an assessment of potential impacts from soil improvements based on available information, and where data is not available, making reasonable assumptions.	Assessment of impacts on soil quality included in section 8.6.3 of the ESIA

ASPECT	ITEM	COMMENT (SIPC)	RESPONSE (TOTAL)	NOTE
			SIPC: Need for approval of potential dumping sites is understood. Currently, no significant dumping is foreseen.	
	7.10	Waste management and final disposal to Be'ah and financial implications for it can be detailed in the waste section/s of the study	Waste management practices will be described based on available information, and environmental implications assessed based on waste management hierarchy. Please kindly clarify "financial implications".	Waste management practices described in section 9.5.4
	7.11	Potential lay down location and main activities should covered in the study.	Yes confirmed, based on available information and reasonable assumptions where data is not available.	Included in Section 3 of the ESIA based on available project data information
	7.12	Non- routine events should be defined and assessed.	Yes confirmed, based on available information and reasonable assumptions where data is not available.	Included in Section 8.10 of the ESIA based on available information
	7.13	Baseline project location soil quality you can refer to SIPC & SFZ soil survey guideline as it is needed for any project.	The need for a Zero Soil Survey will be specified in the ESIA.	Considered in Section 8.6.3 of the ESIA
	7.14	Regarding the Acid Gas Removal Unit (AGRU), is the acid gas flare/incinerator?	The acid gas is incinerated.	

APPENDIX F RESPONSES TO SIPC COMMENTS ESIA REPORT VERSION B

<table>
<tr><th></th><th>Comments SIPC to the ESIA, the BAT study, QRAs and MARSA Safety Report</th><th>Comment Resolution in the ESIA and in the BAT (Appendix G of the ESIA)</th></tr>
<tr><td colspan="3">Annex 1: ESIA Study for TOTAL MARSA LNG Bunkering Project in Sohar Port</td></tr>
<tr><td colspan="2">Water and Wastewater</td><td></td></tr>
<tr><td>1.1</td><td>Wastewater treatment plants was mentioned in fig 3.2 in addition, process water was mentioned in the report of 10 m3/hr is needed for operational phase of the project; however, there was not enough details on; how the water will circulate in the process, the treatment process of the water, and how will manage the residual remaining (sludge) from the wastewater treatment plant. This information must be added in the report.</td><td>Details provided in Section 3.7.5 on the flowrate of process water estimated for the operation phase and how it will circulate on a intermittent basis.

Details provided in Section 3.7.11 on the planned effluent management (wastewater will be collected at the plant to be later exported to an external treatment unit of an authroizised company operating in the Sohar Port. Water will only be discharged to sea if compliant with relevant standards it must be sent to the Sohar treatment plant for treatment and safe disposal).

Figure 3.2 corrected replacing the name of "wastewater treatment" to "storm water basin"</td></tr>
<tr><td>1.2</td><td>Table 8.39 “SW2 – Contamination of storm water runoff from waste and hazardous material spills”. It was mentioned “Ensure storm water is appropriately collected and channeled into the storm water drainage system.”
The storm water drainage system is designed for the common area only and not for industrial plots. The common practices in Sohar Port for storm water management is to store in rainwater basin and then to be analyzed before either discharge to sea or send for the treatment plant. This information must be added in the report.</td><td>Box 8.6 has been updated as well as Section 8.5.5.3 to indicate that once hydrotesting is completed, the water will be contained for anlaysis. If the water is compliant with relevant standars (e.g., MD159/2005, RD 114/2001, and RD 26/81), it will be discharged to the sea. If the water is not compliant, it will be disposed of by an authorized company operating in the Sohar Port.</td></tr>
<tr><td>1.3</td><td>In page 166: the hydro test water is not allowed to dispose directly to the sea. It should be checked first as per MD 159/2005 before discharge of any liquid to the sea. This information must be added in the report.</td><td>Section 3.7.5.1, 3.7.11, 8.5.3, 8.5.4 and 8.5.5 have been updated with regards to the management of hydrotesting water.</td></tr>
<tr><td colspan="2">Mass Balance</td><td></td></tr>
<tr><td>2.1</td><td>In the scoping report approval comment it was requested to "Please give a detailed project description in the EIA report that detailed main process lines and associated units with flowcharts and mass balances". The main flowchart was present but without mass balance. In addition, a mass balance was expected for air emissions from the project. This information must be added in the report.</td><td>Section 3.3.1 mass diagram attached providing details on the mass balance. Streams are detailed in the mass balance (including air emissions and wastewater discharge)

Section 3.7.7 provides the estimation of the air emissions expected and from which equipment (incinerator, NRU, furnace and flaring system). Section 3.7.11 provides details on the wastewater streams that will be generated.</td></tr>
<tr><td colspan="2">Impact assessment</td><td></td></tr>
<tr><td>3.1</td><td>The impact was assessed based on: type, Duration, Frequency, Extent, Magnitude, and Sensitivity only. However, the impact scale “Scale: The size of the impact (e.g., the size of the area damaged or impacted the fraction of a resource that is lost or affected, etc.)” was not assessed as proposed. Could you please justify the same or add the scale of the impact in chapter 8 of the report. (refer to section 8.2.4.2)

<table><tr><td colspan="7">Potential impact descriptors for AQ1</td></tr><tr><th>Type</th><th>Duration</th><th>Frequency</th><th>Extent</th><th>Magnitude</th><th>Sensitivity</th><th>Significance</th></tr><tr><td>Direct</td><td>Long-term</td><td>Temporary</td><td>Local</td><td>Medium</td><td>Low</td><td>Minor</td></tr></table></td><td>Section 8.2.4.2, note explaining the scale characteristic. It should be noted that the extent characteristic is the preferred term as scale is mostly used when there are quantitative values available and for small scale projects where the size of the area potentially impacted can be quantified in an easy manner. For this Project, the scale will typically be the Project site/reclaimed area or will be the same as the extent characteristic as the numerical size of the impact will be too big to (i.e. at a regional and/or international level) to quantify. For this reason, when assessing each on of the impacts the Type, Duration, Frequency, Extent are characterised.</td></tr>
<tr><td colspan="2">Missing Elements/sections: There are some missing elements that were expected to be in the ESIA that need clarification or added as in the following:</td><td></td></tr>
<tr><td>4.1</td><td>Flowchart of major and sub-processes and how they are interconnected, included were emissions to air and discharge to water are to be expected.</td><td>Section 3.3.1 mass diagram attached providing details on the mass balance.

Section 3.7.7 provides an estimation of the air emissions expected and from which equipment (incinerator, NRU, furnace and flaring system).</td></tr>
<tr><td>4.2</td><td>Inclusion of the study of the impact of the commissioning period of the project and its duration.</td><td>Section 3.2 and section 3.4 describe the commissioning phase (which is included within the construction phase) and section 8.5 assesses the impacts of the commissioning phase and the construction phase (in the same subsections). In some areas, we have used the term "construction" instead of "construction and commissioning".</td></tr>
<tr><td>4.3</td><td>Benchmarking:
o Benchmarking of impacts from similar projects around the world with the current project, how to minimize those impacts and mitigation measures (local, regional and international).
o Benchmarking for the applicable laws for the project (local, regional and international) for similar types of projects.</td><td>Section 8.1 updated to include explanation of other international projects and best practice used for the impact assessment and mitigation measures as well as reference to applicable laws. Commitment added in Section 9.3 that the MARSA LNG LLC Oman technical team will ensure that their contractors comply with relevant legislation and standards as indicated in Section 9.1.3. which refers to Section 2 and Annex A of the ESIA.</td></tr>
</table>

	Comments SIPC to the ESIA, the BAT study, QRAs and MARSA Safety Report	Comment Resolution in the ESIA and in the BAT (Appendix G of the ESIA)
4.4	Studying all possible scenarios for **abnormal operation** (ODNOC: other than normal operating conditions) and the **worst-case scenarios** and its (estimated) quantified **impacts.**	Section 8.9 Accidental and non-routine events evaluates the assessment of accidental/non-routine events (i.e. unplanned events). In the context of the ESIA an unplanned event is an event which is not part of routine operation and that may result in significant environmental or social effects. The main unplanned event associated to LNG plants operation is an uncontrolled loss of containment at the plant (described in Section 8.9.2), leading to: Jet, pool and flash fires scenarios across the plant; Overpressure effects in case of an explosion; Cryogenic burns and Toxic dispersion. In addition, abnormal operations (i.e. for example start up operations) have been included in the assumptions taken into account in the air emissions modelling and the results have been assessed in section 8.5.1 AQ1.
4.5	Inclusion of the study of impact of **periodic maintenance of the project and the cycle of performing it**, and associated impact/emissions (if any).	Inclusion in Section 3.5 a description of the planned maintenance activities has been added. The impacts related to these activities involve waste generation and air emissions. The modelling results of air emissions detailed in section 8.5.1 AQ2 and AQ3 take into account the air emissions associated to maintenance activities. Section 3.7.10 has been completed with the expected waste to be generated during the maintenance activities.
4.6	**Waste management plan** must include at the very least the following details: o Waste quantities per defined period (e.g. month, year) o Classification and type of waste o Final disposal/recycling	Details provided in Section 3.7.10 with regards to waste management. Section 9. 5.4. completed to ensure that it will include the details indicated by SPIC.
4.7	The storage area for both solid and liquid wastes needs details on the **storage capacity and storage design.**	Details added in Section 3.7.10 with regards to storage capacity and design.
4.8	**Dark Smoke** from flare prevention? Steam injection in the **flare system** is not mentioned.	Section 3.3.1 Clarified that a "Multi-arm with variable slot HP flare tip" technology valued for high combustion efficiency and non-assisted smokeless operation. Thanks to this technology, no steam injection is foreseen.
4.9	It was mentioned that **Laydown** is needed, however, is was not highlight the locations for it, it is recommended to list down the considerable options (if possible at this stage to avoid separate approval for laydown).	The list of considered options for external laydown areas has been provided in Section 3.4.2. These considered options will be updated once the laydown areas are determined.
4.1	Do you expect a **high noise emission during Flaring**?	Section 3.7.9, it has been specificied that the highest noise level is expected during non-routine operation such as start-up or emergency depressurization. However, as per Project specification, noise level at plant fence will not exceed 115 dB(A) during those non-routine cases. In continuous mode, the maximum allowable noise is 85 dB(A) at Plant fence. Those thresholds are in compliance with SIPC criteria of 85 dB(A) at Tenant fence (ie Marsa Plant) and 70 dB(A) at SIPC fence during normal operation. Section 8.5.2.3 provides the assessment of nosie during operations of the LNG, including during the flaring activiites (start up).
4.11	**Refrigerant** types were not mentioned. It was mentioned Non-ODS, but which type R134a, R410, R411 etc.? as some of the refrigerants might have zero Ozone Depletion Potential (ODP) but high Global Warming Potential (GWP). A list of all possible refrigerants that will be used in the system.	Section 3.3.1, types of refriegerants that may be used for chilled water and air cooling system have been listed. The operations are intended to use Non-ODS refrigerants and specifically those with a low GWP (i.e. non HFC refrigerants). This is also outlined in Appendix D Climate Affairs study. The ESMP also includes a commitment to carry out a GHG management and reporting plan.
4.12	Connections to a potential standard future LNG truck loading unit is considered an option but not yet confirmed -> Assessment done to make the application more flexible for implementations and no ESIA updated will be needed;	Section 3.3.1 , it has been clarified the connections with the standard future LNG truck loading unit.
4.13	Section 3.4, "Depending on the quality of the reclamation material and area with higher load, some soil improvement might still be required such as deep soil improvement and/or stone columns." -> To include it in the assessment for better and more flexibility in construction stage. By including in the assessment and the usage of which type of water seawater or other type of water, to avoid any additional approval during construction phase.	Section 8.5.3.3 evaluates the soil improvement aspect. It has been added a sentence to make it more explicite: soil improvements are likely to have a negligible impact as reclaimed soil will be highly modified, compacted, and barren, with typically no soil horizons (i.e. soil has little to no environmental value). As the project location is going to be modified, the impact on soil will need to be revised when the Project location is decided and the ESIA will be updated with this information. Details on the soil improvement with stone column will be provided then.
4.14	IPPC BAT for Energy efficiency; BAT 24 (optimize electric motors) and BAT 26 (optimize pumping systems) to be included.	Section 2.5.1 o the ESIA, sentence included to reference to BAT study carried out including BAT 24 and BAT 26. Please refer to the BAT study to see how the comment has been addressed.
Report Quality		
5.1	“Domestic non-hazardous waste produced at the camp as well as the small quantities of hazardous wastes (e.g., fluorescent lamps, detergents, clinical waste, spent lubricants and filters) will be taken off site and disposed of at the municipal facility in a landfill”. However, the waste should be disposed to be’ah landfill based on the waste acceptance criteria that set by be’ah.	Section 3.7.11, reference to the Be'Ah landfill facility included. Commitment added in the Waste Management Plan in Section 9.5.4 that the waste will need to be disposed of based on the waste acceptance critera set by the landfill facility.
5.2	Low quality of most of the figures in the report for example: figures 8.12, 8.13, 8.14,	Figures 8.12, 8.13, 8.14 modified

	Comments SIPC to the ESIA, the BAT study, QRAs and MARSA Safety Report	Comment Resolution in the ESIA and in the BAT (Appendix G of the ESIA)
5.3	Page 7, "With regards to health conditions, the community's perception is that air quality degradation attributed to industrial activities in the Port has contributed to increasing incidences of asthma and respiratory illnesses and allergies. Main health infrastructure in the area includes public health centres in Falaj Al Qabail and Hallat al Sheikh as well as three private clinics." Based on what? What is the reference of this statement?	Section 6.12.6, clarified that this information was collected during the baseline consultation.
5.4	Mitigation measures repeated in 3 time in the report? Which is unnecessary.	Section 8.11 deleted to avoid repetition
5.5	Figure 1.1 Project site and surrounding infrastructure, "phase 2 of Freezone " it should be Phase 2 and phase 5	Figure 0.1 and Figure 1.1 modified As the project location is going to be modified, the figures will need to be revised when the Project location is decided and the ESIA will be updated with this information.
5.6	Section 1.3.2 "The social AoI has been defined to include a total of 12 villages or settlements located within a 2-Km radius of the Project site," of project or of Port? As 2 km from the project is still within the port area.	Section 1.3.2 and Section 6.3.2, correction made: indeed it is from Port area not Project.
5.7	Section 2.3.1.1 " The Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA) was established on the 9th of September 2007 by Royal Decree no. (90/2007)-> " it should be RD 106/2020 August 2020;	The Environmental Authority (EA; previously called the Ministry of Environment and Climate Affairs, MECA) was established on the 18th of August 2020 by Royal Decree No. 106/2020.
5.8	"The Directorate General of Environmental Affairs (DGEA) within EA provides Guidelines on how EIAs are to be conducted in Oman, and the Environmental Permitting Centre is mandated with the role of coordinating the ESIA process and issuing preliminary and final environmental permits." -> is should be Permits and Assessment Center and same in table 2.3	Changed to '*Environmental Assessment and Permit Centre* '
5.9	Section 3.1.1 "Section 0", update section number.	Cross reference updated
5.1	Section 3.3.1 " Nitrogen will be used for plant operation and maintenance and will " -> in what??	Section 3.3.1, clarified that TOTAL will use nitrogen for plant operation and maintenance. Typically, nitrogen will be used as blanketing gas, purged gas, rotating machines seal gas and also as sweeping gas (e.g. for the Flare). Unless necessary, no nitrogen will be imported during operation as nitrogen will be extracted from feedgas. Recovered nitrogen will be either under gaseous form, so-called Gaseous Nitrogen (abbreviated as GAN) or under liquid state, so-called Liquid Nitrogen (abbreviated as LIN)
5.11	Section 3.7.10.2, different waste shall have different approach, operation waste management should be more specified than construction waste and should identify storage capacity.	Section 3.7.10 different types of waste effluents and the storage methods are specified.
5.12	Figure 5.5, map legend is missing.	Figure 5.5: legend of the map provided
5.13	Ministries naming to be updated in Section 6.3.4 and Table 7.1.	Updated in Section 6.3.4 and Table 7.1
5.14	6.10.7 Energy: Wadit Jizzi Power plant is not operational anymore since 2018, however, a new power plant in the port is went operation called Shinas power generating company with 1700 - 1800 MW	Section 6.10.7. Modification implemented.
5.15	Section 8.5.1.4, "Operation Phase" the first two points are repeated twice.	Section 8.5.1.4 Repetition removed
5.16	Table 8.8 MARSA LNG LLC's Risk Assessment Matrix Matrix picture is not complete, redo the table	Table 8.8. Figure reviewed
5.17	8.10.2.2 SIPE-> SIPC	Section 8.10.2.2 Corrected
BAT Assessment		
6.1	Include this report as part of the ESIA report	Included as Appendix G of the ESIA
6.2	Section 6.2.1 why the same table repeated?	Modification implemented
6.3	Section 7.2 unit 2 BAT#-> which BREFs file you referring to?	BREF for Refining added
6.4	Attachment 1 - BAT Qualitative Assessment Table: -> tables are not clear -> split in many pages or attached the original file as annex of this document	To ease the reading, the excel sheet is provided in attachment
6.5	Attachment 2 - BAT Evaluation Results: -> to specify the header for Sulphur recovery unit and it is not clear what standard will be followed for compliance for this unit.	Header and standard clarified
6.6	Table 8 and 9: BAT Evaluation Results, the colors indication should be given.	the colors explanation are given in the Attachement 2
6.7	List of the emission values present in "APPENDIX C" should be also mentioned in chapter 8 of the report and BAT report.	modification proposed to be reviewed
Comments resolutions		
6.8	The Comment Resolution for this Annex should include in the updated ESIA report	Included as Appendix F of the ESIA
Annex 2: Total MARSA LNG QRAs and MARSA Safety Report		
6.9	Since the Total MARSA LNG project is projected in an industrial area, no objections are seen considering the surroundings, although some extra attention may be given to the safety distances within the plot plan. The plot plan shows that the most hazardous objects are not close to the plant boundary and effect-minimalizing measures are foreseen. It is recommend to use **higher resolution map**s in the reports and it should show the full contour lines.	Higher resolution maps will be provided in the next QRA revision

APPENDIX G BAT ASSESSMENT REPORT

BAT ASSESSMENT REPORT			Document Number: **OM-SOH-00-TOTA-000128**	
			Revision: **03**	Step: **AFU**
			Date: **31/Aug/2023**	
			Page 1 of 64	
Doc Type: **REP**	System: **00**	Discipline: **PRO**	Phase: **OV**	Class: **1**

Marsa LNG	MARSA LIQUEFIED NATURAL GAS	TotalEnergies

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BAT ASSESSMENT REPORT

Rev.	Step	Date	Revision memo	Issued by	Checked by	Approved by
03	AFU	31/Aug/2023	Approved for Use	*V. DRENO*	*F. CHANTANT*	*H. SAINT GERMAIN*
02	AFU	01/Aug/2023	Approved for Use	*V. DRENO*	*F. CHANTANT*	*H. SAINT GERMAIN*
01	AFU	08/Mar/2021	Approved for Use	*L. GAMIETTE*	*F. CHANTANT*	*H. SAINT GERMAIN*
00	AFU	26/Nov/2020	Approved for Use	*L. GAMIETTE*	*T. TORP ANDERSEN F.CHANTANT*	*H. SAINT GERMAIN*

TABLE OF REVISIONS

Revision	Modification
00	Approved for Use
01	Approved for Use - Modifications including comment received
02	Modified based on CFT updates
03	Update of NOx and CO limits for Acid Gas Thermal Oxidizer (Unit 2)

TABLE OF CONTENTS

1. INTRODUCTION **5**
2. PURPOSE **7**
3. REFERENCES **7**
4. DEFINITIONS **7**
4.1 ABBREVIATIONS 9
4.2 LIST OF HOLD 10
5. SCOPE OF THE STUDY AND OBJECTIVES **11**
5.1 GENERAL INFORMATION 11
5.2 ENERGY AND ENVIRONMENTAL ASSESSMENT 12
5.3 REGULATORY BACKGROUND 12
5.3.1 The IED Directive *12*
5.3.2 The EU BREFs *13*
5.4 SCOPE OF BAT ASSESSMENT 13
5.5 METHODOLOGY OF THE BAT ASSESSMENT 14
6. SELECTION OF UNITS TO ACCESS FOR BAT **15**
6.1 UNITS OF THE PROJECT 15
6.2 CRITERIA OF SELECTION AND SELECTED UNITS FOR THE BAT ASSESSMENT 15
6.2.1 Qualitative assessment on Energy & Emissions for Main Process Units *16*
6.2.2 Qualitative assessment on Energy & Emissions for Utilities *17*
7. BAT ANALYSIS **17**
7.1 UNIT 1 – ENERGY EFFICIENCY AT INSTALLATION LEVEL 17
7.2 UNIT 2 – ACID GAS THERMAL OXIDISER 21
7.3 UNIT 3 – HEATING MEDIUM 25
7.4 UNIT 4 – WARM END 25
7.5 UNIT 5 - NITROGEN REMOVAL UNIT 26
7.6 UNIT 6 – HEAT EXCHANGERS 27
7.7 UNIT 7 – POWER SUPPLY AND ELECTRIC MOTORS 29
7.8 UNIT 8 – LIQUID PUMPING SYSTEMS 31
7.9 UNIT 9 - LOADING, UNLOADING & STORAGE 32
7.10 UNIT 10 – FLARE 37
7.11 UNIT 11 – WATER MANAGEMENT 38
7.12 UNIT 12 – OTHER UTILITIES 42
7.13 UNIT 13 - MONITORING 44
8. CONCLUSION **47**

I. INDUSTRIAL EMISSIONS DIRECTIVE 49
II. BAT EVALUATION METHODOLOGY 50
III. TECHNOLOGIES EVALUATION 51
A. BACKGROUND 51
B. ACID GAS STREAM COMPOSITION AT DESIGN AND EXPECTED CONDITIONS 54
C. EXPECTED EMISSIONS FROM THERMAL OXIDISATION 55
D. ENVIRONMENTAL EMISSION LIMITS FOR BAT ASSESSMENT 56
E. TECHNIQUES FOR SULPHUR RECOVERY QUALITATIVE ASSESSMENT 56
F. QUALITATIVE ASSESSMENT OF SULPHUR ABATEMENT TECHNIQUES 58
G. BAT EVALUATION FOR SULPHUR REMOVAL 60
H. BAT EVALUATION CONCLUSIONS 63

1. INTRODUCTION

The MARSA LNG project will develop in Oman a regional hub for LNG bunkering service to ultimately supply LNG as fuel to marine vessels. The feed gas will come from COMPANY's equity gas entitlement of Greater Barik field located in Block 10.

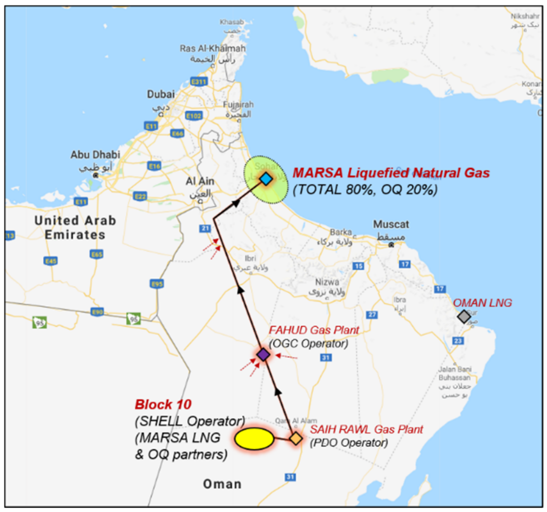


Figure 1 - Project General Context

The MARSA LNG project will build a new onshore midscale LNG plant in the Economic Exclusive Area of the port of SOHAR. The designated zone is an existing reclaimed area under the responsibility of the SOHAR Port Authorities.

The MARSA LNG project foresee the following main facilities for the PLANT:

- LNG facilities with a LNG Train of about 1 mtpa capacity treating 150 mmscfd yearly average of feed gas, with associated inlet facilities, gas pre-treatment, HHC removal, Liquefaction, NRU, LNG storage tank and utilities systems with necessary storages;
- Marine facilities with a jetty fit with offloading facilities for bunker vessels and/or LNG Export Carriers;
- Utilities import facilities from third parties,
- Power import facilities from a new-built Solar Plant and/or from national grid,
- Operating support facilities.

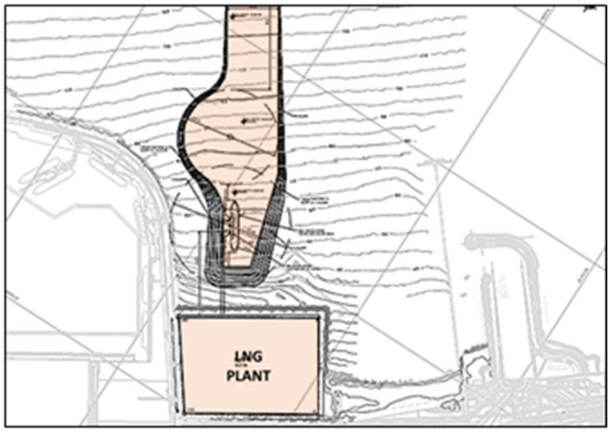


Figure 2 - MARSA LNG Project Situation Plan

2. PURPOSE

The concept of Best Available Techniques (BAT) is part of the IED (Industrial Emissions Directive 2010/75/EU dated 24/11/2010). This European Directive aims at achieving a high level of environmental protection through integrated prevention and reduction of pollution from Industrial activities.

This report applies the BAT assessment methodology to MARSA LNG Bunkering Project, which is in FEED Update phase to demonstrate the compliance of the project to BATNEEC (Best Availlable Techniques not entailing excessive cost) as defined in the Royal Omani Decree RD 114/2001 Conservation of the environment and prevention of pollution.

3. REFERENCES

Reference Number	Document Number	Document Description
1	N/A	Directive 2010/75/EU
2	N/A	Directive 2015/2193

4. DEFINITIONS

For clarification purposes, the definitions used in the present document are:

COMPANY	TOTAL E&P OMAN DEVELOPMENT B.V.
ENGINEERING DELIVERABLE	ENGINEERING DELIVERABLES means all documents and data to be prepared or submitted by CONTRACTOR as described in EXHIBIT D including the BASIS OF DESIGN as adjusted by CONTRACTOR, calculation notes, data sheets, computer data, specifications, drawings, plans, sketches, models, procedures, calculations, and the like.
CONTRACTOR	Company selected by COMPANY for the MARSA LNG BUNKERING Project for EPSCC (Engineering, Procurement, Supply, Construction and Commissioning).
STUDIES	Means the performance of all engineering work performed by CONTRACTOR during FEED and CALL FOR TENDER Phase.
PLANT	Means the permanent facilities.
SITE	SITE means the onshore location in the Sohar Port, Oman where the PLANT is to be constructed.
AVERAGE RATE	Targeted average annual production flow rate expressed in daily production basis (MMSCFD). The AVERAGE RATE is used to calculate cumulative production volumes.

NOMINAL RATE	Production flow rate expressed in daily production basis (MMSCFD) required in order to cope with scheduled and unscheduled downtime and used for PLANT design. The AVERAGE RATE is derived from the NOMINAL RATE by applying the global plant availability factor. The DESIGN RATE shall be the NOMINAL RATE.
TENDERER	Shall be read as CONTRACTOR during the tendering phase.

4.1 ABBREVIATIONS

Abbreviation	Designation
AGRU	Acid Gas Removal Unit
BFD	Block Flow Diagram
BOD	Basis of Design
BOG	Boil Off Gas
BOR	Boil Off Rate
BS&W	Basic Sediments and Water
CAPEX	CAPital EXpenditures
EFG	End Flash Gas
EPSCC	Engineering, Procurement, Supply, Construction and Commissioning
EOS	Equation Of State
FEED	Front End Engineering Design
FOB	Free on Board
GAN	Gaseous Nitrogen
GS	General Specifications (COMPANY)
GTG	Gas Turbo-Generator
HAR	Hot Air Recirculation
HHC	Heavy Hydrocarbons
HMB	Heat and Mass Balance
HSE	Health, Safety & Environment
LIN	Liquefied Nitrogen
LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas
MDE	McDermott
MMSCFD	Million Standard Cubic Feet per Day
MR	Mixed Refrigerant
MTPA	Million Ton Per Annum
NRU	Nitrogen Rejection Unit
OGC	Oman Gas Company
OTT	OilTanking Terminals
OPEX	OPErating EXpenditures
PDP	Process Design Package
PCHE	Printed Circuit Heat Exchanger
P&ID	Piping and Instrument Diagram
PFD	Process Flow Diagram
RAM	Reliability, Availability and Maintainability
SMR	Single Mixed Refrigerant
SOW	Scope of Work

Abbreviation	Designation
TEC	Technip
TDR	Tenderer
VSD	Variable Speed Device

4.2 LIST OF HOLD

Not applicable.

5. SCOPE OF THE STUDY AND OBJECTIVES

5.1 General Information

MARSA LNG Project consists of an onshore PLANT treating a pipeline quality gas to produce around 1 MTPA LNG primarily dedicated to provide LNG bunkering fuel to marine transportation carriers at Sohar Port, Oman.

The Feed Gas is fed from the Oman gas pipelines network downstream a C2+ extraction plant and will be delivered by Oman Gas Company at a yearly feed gas AVERAGE RATE of 150 MMSCFD to the MARSA LNG Plant inlet. From this AVERAGE RATE, COMPANY expects a NOMINAL RATE of about 158 MMSCFD.

At the MARSA LNG Plant inlet, the gas needs to be demercurised upstream the AGRU in order to avoid contamination of the train and dehydrated before reaching the cold end.

The heavy hydrocarbons and benzene have to be removed via an NGL recovery unit before liquefaction. Condensates need to be stabilised and exported by pipeline to near tank farm (OTT). Nitrogen shall be removed to respect the LNG specifications. The LNG is sent from the train to an onshore storage tank, before being loaded to bunkering vessels or LNG carriers via a dedicated LNG marine terminal (jetty and associated LNG loading system). The Boil Off Gas (BOG) generated at the LNG storage tank and loading system is recycled to the PLANT.

All compressors are electric driven and the electricity for the whole plant will be imported from the grid.

Also, air is selected as the main cooling medium for the Project.

The following schematic presents a simplified block flow diagram with the main process battery limits:

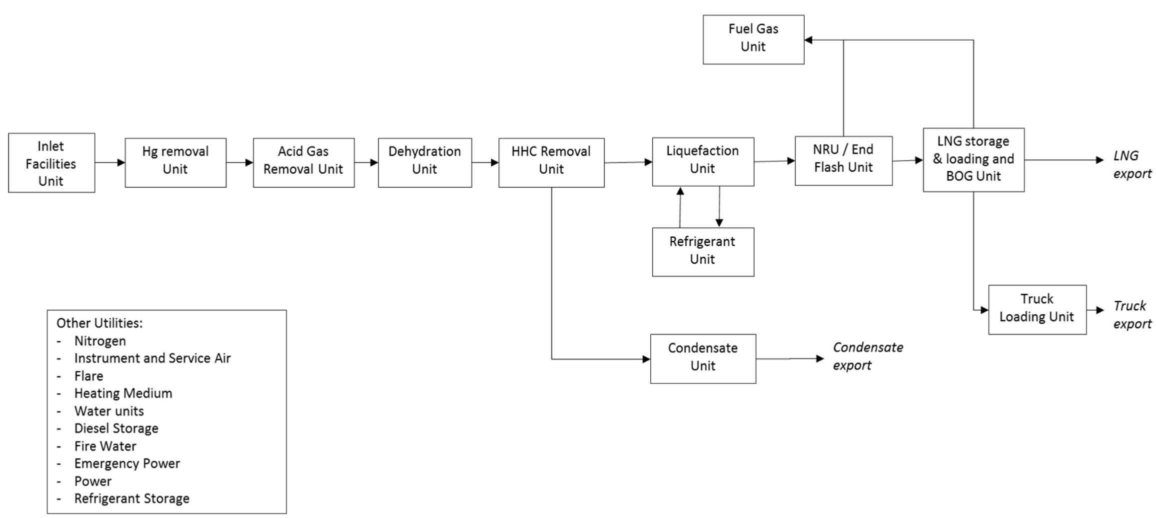


Figure 3: Simplified Block Flow Diagram

5.2 Energy and Environmental assessment

The MARSA LNG Project is in the FEED Update phase. As per TotalEnergies technical referential, commitments to sustainable development as well as efforts to maximise the production of commercial LNG, energy efficiency is one of the criteria used during development studies to choose among the various possible development schemes. A consistent methodology is implemented to calculate Energy Efficiency Key Performance Indicators or KPIs (Energy intensity, auto-consumption and energy efficiency) defined in COMPANY's guides and specifications. Those KPIs are part of the requirements for internal validation committees. The calculation of GHG emissions is also a requirement as per internal COMPANY rules and specifications.

A systematic approach to energy efficiency improvement is recommended for development studies including a functional blocks' analysis. As part of a FEED, energy efficiency KPIs and emissions have to be calculated for various operating conditions and at various stages of the field life in order to investigate the optimum energy efficiency.

This study on Best Available Techniques by functional blocks is part of that ambition. The selected power distribution philosophy for the MARSA LNG Project is such that all machines will be driven by electrical motors and power will be imported externally from grid. Therefore, the key parameter for energy efficiency and GHG emissions of the power load and the corresponding fuel gas are required.

5.3 Regulatory Background

5.3.1 The IED Directive

The concept of Best Available Techniques (BAT) is part of the IED (Industrial Emissions Directive, 2010/75/EU, dated 24/11/2010). This European Directive aims at achieving a high level of environmental protection through integrated prevention and reduction of pollution from industrial activities.

The IED covers industrial activities with a major pollution potential, defined in Annex I to the Directive (energy industries, production and processing of metals, mineral industry, chemical industry, waste management, rearing of animals, etc)

The IED details the conditions for the above polluting industries to support the granting construction and operation permits. The permit conditions including emission limit values must be based on the best available techniques (BAT). BAT conclusions (documents containing information on the emission levels associated with the best available techniques) shall be the reference for setting permit conditions.

Article 3 of the Industrial Emissions Directive defines the BAT as: "the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environmental as a whole".

This description uses the following definitions:

- **"Best"** means "the most effective in achieving a high general level of protection of the environment".
- **"Available"** are "those techniques developed on a scale which allows them to be used in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the cost and advantages"

- **"Techniques"** includes "both the technology and the way the installation is designed, built, maintained, operated and decommissioned."

The Directive (2015/2193) shall apply to combustion plants with a rated thermal input equal to or greater than 1 MW and less than 50 MW (medium combustion plants) irrespective of the type of fuel they use.

The emission limits from Directive 2015/2193 is considered to be applicable for the diesel engines based on the rated thermal input being less than 50MW.

Note: As part of the FEED Update phase, the previous process fired heater was replaced by electrical heaters, therefore Heating Medium is no more subject to emission limits.

5.3.2 The EU BREFs

The European commission has published reference documents on Best Available Techniques, known as BREF (BAT reference). These guidance documents are intended to support BAT assessments within the EU and set out indicative BAT associated emission limits (BAT-AELs) and BAT associated environmental performance limits (BAT-AEPLs) for various sectors and technologies, whilst recognizing that BAT is variable and must be assessed on a case by case basis.

BAT is a dynamic concept and so the review of BREFs is a continuous process.

The following BREFs are relevant for our study:

- Energy Efficiency (revision of Feb 2009),
- Refining of Oil and Gas (EUR 27140 EN, revision of 2015)
- Emissions from Storage (revision of July 2006),
- Industrial Cooling System (revision of December 2001),
- Monitoring of Emission to Air and water (EUR 29261 EN, revision of 2018).

The BAT recommendations stated in the BREF, which are relevant for the units selected in this study are mentioned in section 7.

It shall be noted that no BAT are specifically addressing the LNG industry.

5.4 Scope of BAT Assessment

The objective of this BAT assessment study is to demonstrate that the design of the project minimizes as much as possible its future impact on the environment and implements the most efficient technologies of the market from an environmental point of view (BAT concept). The aim of this study is to have a systematic analysis of the project functional blocks. This study will summarise opportunities, if any, to improve the environmental performance and energy efficiency within the design options, focusing on the main emissions sources.

The battery limit of the study is the MARSA LNG Project is as defined as per Figure 3.

The study covers the production phase, from start up till end of life of the facility. The construction and commissioning periods are excluded for the purpose of this study.

The BAT assessment focuses on the technical choices for normal operating conditions allowing the improvement of the environmental performance. Start-ups, shutdowns and degraded or emergency situations being as well causes for emissions, reliability and flexibility of the process to mitigate those situations are key parameters in the technological choices.

When relevant, the criteria related to Reliability, Flexibility, Operability, Safety and Costs are mentioned.

5.5 Methodology of the BAT Assessment

The Best Available Techniques recommended in the EU BREF documents are used as the reference point to access the environmental performance with this project.

The EU recognises that the implementation of BAT in new or significantly upgraded plants or processes is not usually a problem. In most cases, it makes economic sense to optimise energy efficiency.

The EU BREFs emphasize that the key element to enhance energy efficiency “at an installation level”, as defined in the BREF, is to implement a formal management system dedicated to Energy Efficiency. These techniques are applicable for all installations. The scope and techniques used depend on the scale and complexity of the installation, and the energy requirements of the system’s components.

Therefore, the first recommendation, at the project level, is the implementation of an operating philosophy and a project management system in which the energy efficiency is a key parameter. The first BAT assessment (Unit 1) will therefore target the Energy Efficiency Management System as described in the Operating Philosophy of the Project

The rest of the BAT assessment put emphasis on pollution prevention techniques along the process rather than the end of pipe treatment, where possible. Therefore, the MARSA Project has been split into a number of key units. The intent of the BAT is not to review in detail each equipment items of the PLANT but to focus on the different Process systems, which correspond to the key units defined for the study.

The following criteria (as per Annex III, IED 2010/75/EU), have been used to assess each technology option:

- Use of technology generating less waste, with less hazardous substances.
- Use of technology that promotes recovery and recycling of substances and heat generated from the process, where appropriate
- Use of technology that have been employed with success on an industrial scale
- Use of technological advances to improve and / or replace conventional technology
- Use of technology with less emissions, discharges, noise and vibration.
- Consume less raw materials (including water) in the process and their energy efficiency.
- Need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it.
- Need to prevent accidents and to minimise the consequence for the environment.

The assessment has been conducted by using the engineering deliverables produced along the past competitive FEED engineering, plus the new engineering deliverables re-issued as part of the FEED Update phase/

6. SELECTION OF UNITS TO ACCESS FOR BAT

6.1 Units of the project

For the purpose of this study, the below process functions of the PLANT are split into following units.

LIST OF UNITS				
Inlet facilities	LNG PLANT		STORAGE & HANDLING	UTILITIES
	Warm End	Cold End		
Pigging station	Mercury removal	HHC Removal	LNG storage	Fuel Gas
Feed Gas Separator (Filtration)	AGRU *Incineration included*	Liquefaction	Refrigerant storage	Heating Medium
Feed Gas Metering	Dehydration	Nitrogen Removal	BOG Compression	Flare / Closed Drain Marine Flare included
Feed Gas Heater	Condensate Stabilisation		LNG Loading system from pumps to PERC	Diesel system
				Open drain
				Nitrogen system
				Air Instrument system
				Waste treatment
				Potable water treatment
				Lightning, HVAC
				Control room and camps

Figure 4: List of Units in the PLANT

6.2 Criteria of selection and selected units for the BAT assessment

The objective of this BAT study is to assess this project from the point of view of

1. Minimization of the environmental impact
2. Optimisation of the energy efficiency

The environmental impact focuses on emissions in atmosphere, water and Land. The energy efficiency focuses on the energy consumption and the energy lost within the envelope of the project. The scope is normal operating conditions, but the criticality in case of accidents in each unit has also been taken into account to select the units to access.

Therefore, the following criteria have been chosen to evaluate the technologies chosen at this stage of project, in terms of environmental impact, energy efficiency and improvement options.

- Generation of emissions, waste and noise under normal operating circumstance
- Use of energy

6.2.1 Qualitative assessment on Energy & Emissions for Main Process Units

	+ Low	++ Significant	+++ Very Significant				
	Emissions, Waste and Noise				Energy Efficiency		
Normal operating conditions	Generation	Toxicity	Frequency of disposal	Quantity of disposal	Use of Energy	Use of Water	Potential recycle and optimisation
Inlet Facilities							
Feed Gas Separator (Filtration)	+	+	+ (*)	+			
Feed Gas Heater					+		
LNG PLANT (Warm End)							
Mercury Removal	+	+	++	++			
AGRU (excluding thermal oxidiser)	+	+	+	+	+	+	+
Acid Gas Thermal Oxidiser	+++	+++	+++ (P)	+++			
Dehydration	+	+	++ (*)	++	+		++
Condensate Stabilisation					++		+
LNG Plant (Cold End)							
HHC Removal					+++		+
Liquefaction					+++		+
Nitrogen Removal	+++	+	+++ (P)	+++	+++		+
Storage and Loading							
LNG Storage	+++	+	+++ (P)	+++	+++		
Refrigerant Storage	++	++	++ (P)	++			
BOG Compression					+++		
LNG Loading system from pumps to PERC	+++	++	++ (P)	++			

Notes:

(P) stands for permanent disposal. As an example, the acid gas thermal oxidiser will generate emissions permanently in normal operation.

(*) for those units, the emissions are non-permanent and, in some cases, very rare in the plant life. For example, emissions can be generated at the pigging facilities when they will be opened for pigging operations, which are supposed to occur once every 4 years for intelligent pigging.

According to the potential emissions and energy consumption of each equipment units of the MARSA LNG Project, the following main process units were further assessed in terms of BAT.

- Acid Gas Thermal Oxidiser
- Mercury Removal Unit
- HHC Removal unit and the Liquefaction Unit in the unit dedicated to Power Supply
- Nitrogen Removal unit
- Liquid pumping system, which is defined by the three main pumps of the Plant in capacity (the LNG rundown pumps, the LNG loading pumps, and the Amine HP pumps)
- LNG and Refrigerant Storage

- BOG Compression and LNG loading system

The AGRU unit and Condensate stabilisation units are not relevant for BAT assessment, as the reboiler duties are supplied by heating medium. The pumps and the air coolers in these units have electrical motors and are addressed in the assessment of power generation and electrical motors.

The other units / equipment of the main processing units are less critical in terms of environmental performance.

6.2.2 Qualitative assessment on Energy & Emissions for Utilities

	+ Low	++ Significant	+++ Very Significant				
	Emissions, Waste and Noise				Energy Efficiency		
Normal operating conditions	Generation	Toxicity	Frequency of disposal	Quantity of disposal	Use of Energy	Use of Water	Potential recycle and optimisation
Utilities							
Fire Water / Esential Diesel Engine	++	++	++ (*)	++			
Fuel Gas					+		
Flare (Marine Flaire included)	+++	+++	++	++	+		+
Diesel system	++	++	+ (*)	+	+		
Closed Drain	+	+	+ (*)	+			
Open Drain					+		
Nitrogen system							
Air Instrument system					+		
Waste Treatment							
Lightning, HVAC					++		

Notes:

(*) for those units, the emissions are non-permanent and, in some cases, very rare in the plant life. For example, emissions can be generated at the diesel system only during operation of the fire water pumps. There is no diesel storage in the base case of the MARSA project.

According to the potential emissions and energy consumption of each equipment units of the MARSA LNG Project, the following Utilities units are assessed in terms of BAT.

- Warm / Cold & Marine Flare
- Lighting / HVAC

The other units / equipment of the utilities are less critical in terms of environmental performance.

7. BAT ANALYSIS

7.1 Unit 1 – Energy Efficiency at installation level

Existing BATs in the BREFs

The BREF on Energy Efficiency develops the following BAT for operators to properly manage their installations:

Page	Level	BAT#	Object
273	Installation	1	Adhere to energy efficiency management systems (ENEMS)
274		2	Continuously minimise the environmental impact of an installation by planning actions and investments on an integrated basis on short, medium, long term
275		3	Identify the aspects of an installation that influence EE with audits
275		4	Definition of the audit (BAT3) criteria
276		5	Use appropriate tools and methodology (energy models, balances) to identify EE optimisations
276		6	Identify opportunities to optimise energy recovery within the installation
276		7	Use a system approach to energy management
277		8	Establish EE indicators
278		9	Perform regular benchmarks
278		10	Implement Energy Efficent Design qt early stage engineering
279		11	Increase process integration
279		12	Maintain the impetus of energy efficiency initiatives
280		13	Maintain expertise with proper staff reruitment and training
280		14	Implement effective control of processes
281		15	Maintenance operations to take into account EE
281		16	Establish and maintain documented procedures to monitor and measure EE

The BREF on Refining of Oil and Gas also adds the following BATs:

Page	Level	BAT#	Object
592	Energy efficiency	2	Design techniques: heat integration, heat and power recovery Process control techniques: process optimisation (lower fuel consumption), monitoring and benchmark

Evaluation of MARSA LNG Project

The Operating Philosophy at FEED phase gives indications on how emissions, waste, noise and energy efficiency management systems will be implemented in the future Operating Manuals and Procedures.

The following key design principles are taken into consideration in the operating philosophy:

- No operational flaring, with minimal natural gas flaring that may be required for emergency situations and start-up/shutdown operation for safety purpose.
- No continuous venting of natural gas.
- Design shall minimize volatile organic carbon and odour emissions.
- Energy efficiency shall be optimized throughout design.

The objectives of the MARSA LNG operating philosophy is to:

- Achieve a high level of operational safety and minimal environmental impact in line with local regulatory rules, affiliate policies, Group guidelines and HSEQ objectives.
- .
- Define the Operational Management system, including the relevant key positions to allow for the monitoring of the energy efficiency performances and the environmental impact of the Plant

The reduction of the environmental impact due to the operations of the plant will be based on the following primary management tools:

- Environmental and social Baseline Study (ESBS),
- Environmental Impact Assessment (EIA),
- Socio-economic Impact Assessment (SEIA),
- Environmental Management Plan (EMP).

The performance against the EMP is monitored and mitigation measures identified if necessary.

Energy Efficiency key indicators calculated from FEED phase allow to evaluate the environmental impact of the Plant and drive relevant technique choices. Performance of MARSA LNG operation teams on environmental preservation will be monitored and reported to the relevant authorities on a regular basis as per the detailed Operating Procedures to be developed.

A site specific HSSE management plan (HSSE Dossier) will be implemented. This plan shall obligatorily cover among other things:

- A summary of regulations in force
- Environmental Reporting requirements and recipients of reports,
- Emergency procedures (cross-referenced to ERP)
- DGS (List of downgraded situations on site at any time)

MARSA LNG Project will benefit from TotalEnergies return of experience and internal references regarding the Terms of Reference for the operational audit (internal and externals).

Heat Integration:
Heat Integration depends on the development scheme and therefore in TENDERER dependent. However, it has been thoroughly implemented in the Cold End Units (HHC Removal, Liquefaction and Nitrogen Removal units) by the three TENDERERS.
Heat recovery is a design driver in several units of the plant, as shown in the following examples:

- In the Acid Gas Removal Unit, the rich solvent stream coming from the Rich Amine Flash Drum is preheated with hot lean solvent in the Lean/Rich Amine Exchanger (2x100%, 1 installed, 1 spare in warehouse) prior to feeding the Amine Regenerator.
- For the 3 TDRs, heat integration is ensured between the HHC Removal Unit, the Liquefaction Unit and the Nitrogen Removal Units, allowing to recover power and duty between the units. Depending of the development schemes, the heat recovery can be done within a unit (as the use of turbo-expanders in the HHC removal unit) or between units (as between the Liquefaction unit and the HHC removal unit).
- In the Nitrogen Removal Unit scheme developed by the 3 TENDERERS, there is a stream of cold Mixed Refrigerant flowing through one path of the Heat Exchanger at the stripper Column head in order to reach the reach the specification of Methane in the LIN.

Conclusions

The general BAT principles from the Energy Efficiency BREFs are fulfilled. MARSA LNG design and operation are based on energy efficiency & zero emissions oriented operating philosophy.

Recommendations

- Operating manuals will have to detail how an Energy Efficient Management System shall be implemented as well as the specific training to personnel.

▪ Detailed design of the MARSA LNG Project shall respect the high requirement level in term of availability and robustness.
Potential technological innovation
None at this stage.

7.2 Unit 2 – Acid Gas Thermal Oxidiser

Existing BATs in the BREFs		
In the BREF for Refining of Mineral Oil and Gas, the following BAT are developed		
Page	BAT#	Object
652	BAT 41	In order to reduce SO2 emissions to air from the natural gas plant, BAT is to apply BAT 54. BAT 54 is discussed under BAT conclusions for waste gas sulphur treatment section.
659	BAT 54	In order to reduce sulphur emissions to air from off-gases containing H2S, BAT is to use all of the technique given below, • Acid gas removal (e.g by amine treating • Sulphur recovery units (SRU) e.g by Claus process • Tail gas treatment unit (TGTU) The BAT associated environmental performance levels for a waste gas Sulphur (H2S) recovery system is indicated as 95% to 99.9% with table 5.17. The associated monitoring is described in BAT 4 (Refer to Unit 7.13)
652	BAT 42	In order to reduce NOx emissions to air from the natural gas plant, BAT is to apply BAT 34. BAT 34 is discussed under BAT conclusions for combustion units.
644	BAT 34	In order to prevent or reduce NOx emissions to air from the combustion units, BAT is to use one or a combination of the techniques, i. Primary or process related techniques, such as a. Selection or treatment of fuel: i. Use of gas to replace liquid fuel ii. Use of low nitrogen refinery fuel oil b. Combustion modification: i. Staged combustion ii. Optimisation of combustion iii. Flue gas recirculation iv. Diluent injection v. Use of low NOx burners ii. Secondary or end of pipe techniques, such as a. Selective catalytic reduction (SCR) b. Selective non catalytic reduction (SNCR) c. Low temperature oxidation d. SNOx combined technique

		The BAT associated emissions levels for NOx emissions to air (relevant for gas fired thermal oxidiser) is 100 mg/Nm3 of dry gas @ 3%O2 in volume, as indicated in table 5.10
649	BAT 37	While CO emissions are envisaged from acid gas processes (Refer to Table 8.2), no specific BAT been identified within waste gas sulphur treatment. However, **BAT 37** (under BAT conclusions for combustion units) is considered applicable for the acid gas thermal oxidiser (vapor destruction technique). The BAT-associated emission levels of CO < 100 mg/Nm3 is considered relevant for this Unit 2.
656	BAT 52	While VOC emissions are envisaged from acid gas processes (Refer to Table 8.2), no specific BAT been identified within waste gas sulphur treatment. However, under techniques to reduce the VOC emissions, vapor recovery & vapor destruction (both thermal and catalytic oxidation) were discussed in section 5.20.6 of BREF. While no BAT-AEL been evident for the VOC for discussion under waste gas sulphur treatment, the **BAT 52** (under BAT conclusions for storage and handling processes) provided the Benzene and Non methane VOC (NMVOC) emission levels for loading and unloading operations which is considered relevant for this unit 2. The BAT-AEL for benzene is considered at 1 mg/Nm3 of dry gas @ 3% O2 in volume.
628	BAT 7	In order to prevent or reduce emissions to air, BAT is to operate the acid gas removal units, sulphur recovery units and all other waste gas treatment systems with a high availability and at optimal capacity. Special procedures can be defined for specific operating conditions, in particular i. During start up and shutdown operations ii. During other circumstances that could affect the proper functioning of the systems (e.g regular and extraordinary maintenance work and cleaning operations of the units and / or waste gas treatment system) iii. In case of insufficient waste gas flow or temperature which prevents the use of the waste gas treatment system at full capacity.

Evaluation of MARSA LNG Project

The BAT assessment of this unit is made for a Regenerative or Recuperative Thermal Oxidiser without additional treatment of the flue gas. The different Sox abatement techniques are discussed in detailed in the Appendix A of this report. The conclusion of the Appendix is that it is recommended to consider only Incineration of the flue gas.

With the thermal oxidization to incinerate the H2S & VOCs with the acid gas stream, the expected emission concentration in the incinerator effluent for the design and expected conditions are as below.

Pollutant	Composition 1 – Incinerator Exhaust		Composition 2 – Incinerator Exhaust		Expected – Incinerator Exhaust	
	Concentration mg/Nm3 [2]	*Flowrate Ton/year* [2]	*Concentration mg/Nm3* [2]	*Flowrate Ton/year* [2]	*Concentration mg/Nm3* [2]	*Flowrate Ton/year* [2]
Particulate	Neg [1]	Neg [1]	Neg [1]	Neg [1]	Neg [1]	Neg [1]
H2S	-	-	-	-	-	-
SO2	275	20.95 [5]	2450	20.95 [5]	135 [7]	6.26 [5] [7]
CO	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
CO2		54950 [5] [6]		6800 [5] [6]		33395 [5] [6]
HC	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
NOx	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
Benzene	Neg [4]	Neg [4]	Neg [4]	Neg [4]	Neg [4]	Neg [4]

[1] No particulate emission envisaged as feed & fuel are gaseous.

[2] The values are estimated based on the flue gas factor of 1500 Nm3 (dry basis)/t of Acid gas feed in section 8.6.2 (BREF Refining). This is considered as conservative approach in estimation of flue gas.

[3] CO, unburnt HC & NOx content in flue gas is managed by combustion controls. To be confirmed with vendor feedback.

[4] Benzene destruction efficiencies are expected to be >99.9% and hence no concentration expected. To be confirmed with vendor feedback.

[5] Based on 95% plant availability.

[6] CO2 emission factor of 2.49 kg CO2 /kg of fuel gas considered.

[7] Expected SO2 emission concentration and quantity based on pipeline lab samples collected and 75% H2S absorption efficiency in AGRU.

BAT 34/42: With respect to NOx emissions to air, TotalEnergies internal specification clearly specifies that combustion units shall be equipped with Low NOx burners which is one of the recommended primary emission reduction techniques.

BAT 41/54: With respect to SOx emissions to air, the amount of sulphur that can be recovered as value added product is observed very less (<30 kg/day of elemental sulphur) based on the Acid Gas removal unit Licensor. As such, the base case technique (Regenerative or Recuperative Thermal Oxidiser) is not fulfilling the BAT. It shall be noted that the overall impact on environment of the different abatment techniques have been reviewed and detailed in the Appendix III.

BAT 37: CO emission is completely managed by the combustion control techniques.

BAT 52: Though there was no mention of VOC emission to air from acid gas incineration, as mentioned in earlier, the Benzene emission limit identified for the vapor recovery / vapor destruction techniques with the loading and unloading systems can be observed to be relevant for Unit 2. However, with the expected Benzene in the feed to acid gas thermal oxidiser at 500 – 1000 ppm (v/v), meeting the specification of 1 mg/Nm3 of dry flue gas @ 3% O2 in volume may require a destruction efficiency more than 99.9%.

BAT 7: A high availability have been required by CPY and confirmed by the Vendors in order support the high overall availability of the PLANT.

Conclusions

Regarding the availability and emissions of NOx, CO, VOC the BAT are fulfilled.

Regarding the SOx, the BAT is not fully fulfilled if focusing only on the SOx emissions to air. However, the study of the different abatement techniques concludes that the environmental impact would increase significantly. The following modified limits are proposed to be applied:

Polluants	Unit	PROPSOED BAT Recommendation specification
Carbon Monoxide	g/Nm^3	0.100
Hydrogen Sulphide	ppmv	5
Unburnt hydrocarbons	g/Nm^3	-
Nitrogen Oxides (@ Nitrogen Dioxide)	g/Nm^3	0.100
Sulphur Dioxide	g/Nm^3	-
VOCs	g/Nm^3	0.035
Total particulates	g/Nm^3	0.100
Sulphur recovery efficiency	%	-
Benzene	g/Nm^3	0.001

Therefore, the technique implemented by the MARSA project can be considered as the most effective in term of overall impact.

Recommendations

Not applicable.

Potential technological innovation

Not applicable

7.3 Unit 3 – Heating Medium

As part of the FEED Update phase, the previous process fired heater was replaced by electrical heaters, therefore Heating Medium is no more subject to emission limits.

7.4 Unit 4 – Warm End

Existing BATs in the BREFs

Page	BAT #	Object
652	43	In order to prevent emissions of mercury when present in raw natural gas, BAT is to remove the mercury and recover the mercury containing sludge for waste disposal.

Evaluation of MARSA LNG Project

In the warm end, downstream the Inlet Facilities, the mercury is removed from the feed gas thanks to a mercury bed and after-filters. The bed is to be changed out online, provision for connection of a temporary bed is anticipated.

Conclusions

The Plant is in line with the BAT recommendation regarding the mercury removal.

Recommendations

Not applicable

Potential technological innovation

Not applicable

7.5 Unit 5 - Nitrogen Removal Unit

Existing BATs in the BREFs

It should be noted that there is no specific data on methane emission from Nitrogen Removal units in the BREF (no benchmark of associated emission among the techniques assessed in the BREF). Hence, this section will address the general overview and process control techniques which are considered to reduce the CH_4 emissions.

In order to reduce the nitrogen content in the LNG produced, the cryogenic distillation process of nitrogen removal is employed. Though this process is not discussed within BREF – Refining, through this process, the methane content in the nitrogen removed from process is reduced to 1000 ppm(v) which is the best available performance of such process in the LNG industry. Associated with Regenerative Thermal Oxidiser, the CH_4 emissions will be reduce by min 99.5%

Evaluation of MARSA LNG Project

The Nitrogen Removal unit is considered within the proposed process design, as the feed gas contains considerable amount of Nitrogen in excess to the allowable Nitrogen (inerts) with the LNG product specification (max 1%). This excess nitrogen is typically removed thanks to the following process units.

1. Cryogenic distillation
2. Rubber Membrane
3. Pressure Swing Adsorption
4. Lean oil Absorption

Of the above processes, the first 3 processes are matured and have reference of operating plants and within LNG and gas processing applications, cryogenic distillation or hybrid cryogenic distillation with rubber membrane are commonly applied respectively.

Nitrogen removed from process with a methane content of 1000 ppm(v) is not directly vented to atmosphere but treated in a Regenerative Thermal Oxidiser where min 99.5% of the residual methane is converted into CO_2.

It should be also noted that the nitrogen recovered through Nitrogen Removal unit is also used for all the nitrogen purge requirement within the process units, as LIN and GAN are produced from the NRU.

Conclusions

The selected cryogenic nitrogen removal process with Regenerative Thermal Oxidiser is considered as the best available technique achieving the maximise HC recovery with minimised residual HC in vented Nitrogen.

Recommendations

Non applicable

Potential technological innovation – Non applicable

7.6 Unit 6 – Heat exchangers

Existing BATs in the BREFs

The Following BAT is proposed in the BREF for Energy Efficiency, in the chapter dedicated to "energy-Using", regarding the Heat exchangers:

Page	BAT #	Object
320	19	BAT 19 - is to maintain the efficiency of heat exchangers by both: a. monitoring the efficiency periodically, and b. preventing or removing fouling

In the BREF for Industrial Cooling system, there is one BAT applicable to MARSA project which states the following:

Page	BAT #	Object
125	4.3.1	It is BAT in the design phase of a cooling system: • To reduce resistance to water and airflow • To apply high efficiency/low energy equipment • To reduce the amount of energy demanding equipment

The BREF focuses on cooling towers and water-cooling system. However, it is stated that the major environmental impact of air cooled system is the noise.

Evaluation of MARSA LNG Project

BAT 19: In Units 41, 42, 43, 47 and 46, the heat exchangers (process fluid side) are all equipped with delta P indicators at the minimum in order to monitor the fouling across the exchangers.

Regarding the air coolers, there is no delta P monitoring as such in the process and the air sides. However, the performance monitoring as anticipated in the Operating Procedures allow to monitor the possible fouling of the air coolers. They can be washed on request based on the performance results.

BAT4.3.1: There is no requirement in the TotalEnergies Internal specifications regarding the efficiency or low energy equipment.

The motors of the air coolers are selected among standardized electrical motors by the Vendor for the required power of the PLANT.

As such the BAT is not fully fulfilled. However, it shall be noted that the BREF is mainly applicable to water- or air-cooling towers, applied for larger looing duty than the MARSA LNG Project. It shall be noted that compared to the overall power demand of the PLANT, the air coolers account for less than 1%. Therefore, the energy efficiency loss can be considered very marginal.

Regarding the noise, the noise limits of the plant are driven by the Regulations and specifically by the Omani environmental noise limits (MD 79/94 Article 7). The Air coolers, as one of the major source of

noise in the Plant, are therefore submitted to this limits. A maximum fan noise level of 85 dB at 1 m is considered.
Conclusions
The BAT as described in the BREF Energy Efficiency are fulfilled at this stage of the project. The BAT for Industrial Cooling System is not fully fulfilled. However, it shall be noted that the BREF is mainly applicable to water- or air-cooling towers, applied for larger looing duty than the MARSA LNG Project. It shall be noted that compared to the overall power demand of the PLANT, the air coolers account for less than 1%. Therefore, the energy efficiency loss can be considered very marginal
Recommendations
Air coolers motors oversizing shall be prohibited
Potential technological innovation
Not applicable.

7.7 Unit 7 – Power Supply and Electric Motors

Existing BATs in the BREFs

The Following BAT is proposed in the BREF for Energy Efficiency in energy-Using regarding the Power supply and the electric motors:

321	21	BAT is to increase the power factor according to the requirements of the local electricity distributor
321	22	BAT is to check the power supply for harmonics and apply filters if required
321	23	BAT is to optimise Compressed Air Systems using techniques such as the ones below, -ensure power cables have the correct dimensions for the power demande -use high efficiency/ low loss transformes -place equipment with a high current demande as close as possible to the power source
322	24	BAT is to optimise the electric motors in the followig order: 1-optimise the entire system of the motors 2-optimise the motor in the system according to the newly-determined load requirements by applying different techniques as below (not exhaustive): -using EEM - proper motor sizing -installing VSD -Energy Efficient Motor repair -Using certified rewinding contractor

The BREF for Energy Efficiency provides a list of BAT for the Compressed Air systems, indicating as well that compressed Air systems accounts for as much as 10% industrial consumption of electricity among the benchmark done for the European Guidelines.

323	25	BAT is to optimise Compressed Air Systems using the techniques such as those mentionned below: -overall system design, including multi-pressure systems -improve cooling, drying and filtering -reduce frictional pressure losses -improvement of drives -use external cool air as intake -reduce air leaks -frequent filter replacement -optimise working pressure

Evaluation of MARSA LNG Project

Regarding the BAT 21, several techniques described in the BAT are applied in MARSA LNG Project, such as installation of AC capacitors for reactive power compensation. The use of Energy Efficient motors is driven by International Regulations and CPY internal specifications.

The BAT 22 is fulfilled when applicable. Indeed, 2 architectures are proposed:

- the installation of thyristor and appropriate filters, as recommended in the BAT or
- the use of transistors-based systems which may avoid the necessity to install harmonic filters.

The BAT 23 is fulfilled as the main power cables are properly sized as per International Regulation IEC60287-3-2. A review has been done during the FEED to optimize the power supply and the location of the electrical sub-stations and the major consumers.

Regarding BAT 24, the use of Energy Efficient Motors, and the repair/rewinding in specific workshop, is driven by Regulations and CPY internal Specifications, as the motors will be in ATEX certified. Also, the electrical motor sizing is refined by the Compressor Vendor, avoiding oversizing of the different motors.

The BAT 25 is fulfilled as per the requirements details in the CPY internal specification dedicated to the Compressed Air package. It should be noted that for the MARSA LNG Project, the air compressor power accounts for around 1% of the overall power load of the Plant.

Conclusions

The BAT as described in the BREF Energy Efficiency are fulfilled at this stage of the project.

Recommendations

Not applicable.

Potential technological innovation

Not applicable.

7.8 Unit 8 – Liquid Pumping systems

Existing BATs in the BREFs

The BREF on Energy Efficiency (BAT 26) to optimize pumping systems include various recommendations
such as:

- avoid oversizing of pumps
- match the correct choice of pump to the correct motor for the duty
- use energy efficient motors and variable speed drives
- proper design of pipework system (diameter)
- appropriate and regular control and maintenance
- minimize the number of valves and bends in the distribution system

Evaluation of MARSA LNG Project

The three main pumping systems of the Plant are the

- Rundown pumps, in 2x100%, from the Nitrogen Removal unit to the LNG tanks. They are sized in order to allow the circulation of LNG to the loading lines for cold preservation of the lines in HOLDING mode. In Loading modes, they are used to send the produced LNG (rundown stream) to the tank. Only 1 pump will be operating at any point in time.
- The Loading pumps: there will be three (3) in-tank LNG loading pumps installed in vertical wells. Their rated capacity allows to load either bunker vessel at 2000 m3/h or LNG carrier at 6000 m3/h. It is understood that when loading a Bunker vessel, the pumps will work in a lower efficiency point compared to the loading of a LNG carrier. However, it has been decided at this stage of the project that VSD will not be installed, as it would add complexity in operations and additional CAPEX for low added value in energy efficiency due to the low frequency of the loading operation.
- The Amine HP pumps in the Warm end, which are designed to in 2x100%.

The pipework has been designed as per International codes and TotalEnergies General Specification accounting for slight margin in the diameter of the piping and lines.

The pumps have been designed according to TotalEnergies Technical referential allowing for margin for proper operation for the whole operational range. The motors of the pumps are designed specifically for each type of pump, ensuring no oversizing of the motors.

The Project Maintenance and Inspection philosophies detail the principles applied to MARSA LNG Project in line with TotalEnergies practices ensuring easy access for equipment needing higher level of maintenance like pumps.

Conclusions

The design of the liquids pumps of the plant satisfies the recommendation and criteria for being considered as BAT.

Recommendations

Not applicable.

Potential technological innovation

None.

7.9 Unit 9 - Loading, Unloading & Storage

The BAT regarding the storage are mainly provided by the BREF Emissions from storage. Different BATs are provided depending on the technology of Storage (e.g pressurized storage, mounded storage). Therefore, both applicability of BATs will be highlighted in the following evaluation.

The BREF dedicated to Refining of Oil and Gas also details some BAT regarding the storage and the handling facilities.

Existing BATs in the BREFs

Page	BAT #	Object
287	5.1.1.1	BAT for a proper design is to take into account at least the following: • the physico-chemical properties of the substance being stored • how the storage is operated, what level of instrumentation is needed, how many operators are required, and what their workload will be • how the operators are informed of deviations from normal process conditions (alarms) • how the storage is protected against deviations from normal process conditions (safety instructions, interlock systems, pressure relief devices, leak detection and containment, etc.) • what equipment has to be installed, largely taking account of past experiences of the product (construction materials, valve quality, etc.) • which maintenance and inspection plan needs to be implemented and how to ease the maintenance and inspection work (access, layout, etc.) • how to deal with emergency situations (distances to other tanks, facilities and to the boundary, fire protection, access for emergency services such as the fire brigade, etc.).
287	5.1.1.1	BAT is to apply a tool to determine proactive maintenance plans and to develop risk-based inspection plans such as the risk and reliability based maintenance approach;
287	5.1.1.1	BAT is to locate a tank operating at, or close to, atmospheric pressure aboveground. However, for storing flammable liquids on a site with restricted space, underground tanks can also be considered. For liquefied gases, underground, mounded storage or spheres can be considered, depending on the storage volume.
287	5.1.1.1	BAT is to abate emissions from tank storage, transfer and handling that have a significant negative environmental effect
288	5.1.1.1	On sites where significant VOC emissions are to be expected, BAT includes calculating the VOC emissions regularly.

Page	BAT #	Object
289	5.1.1.2	On sites where significant VOC emissions are to be expected, BAT includes calculating the VOC emissions regularly. For other substances, BAT is to apply a vapour treatment installation, or to install an internal floating roof.
291	5.1.1.2	BAT for draining depends on the tank type, but may be the application of a closed drain system connected to a vapour treatment installation
291	5.1.1.2	For the storage of volatile substances which are toxic (T), very toxic (T+), or CMR categories 1 and 2 in an underground or mounded tank, BAT is to apply a vapour treatment installation. For othe substances, BAT is to do all, or a combination, of the following techniques, depending on the substances stored: • apply pressure vacuum relief valves; • apply vapour balancing; • apply a vapour holding tank; • apply vapour treatment;

The section 5.1.1.3 is related to prevention and mitigation of the risk.

292	5.1.1.3	BAT in preventing incidents and accidents is to apply a safety management system
292	5.1.1.3	BAT is to implement and follow adequate organisational measures and to enable training and instruction of employees for safe and responsible operation of the installation
292	5.1.1.3	Additionally for an underground tank, BAT is to apply to the outside of the tank: • a corrosion-resistant coating • plating, and/or • a cathodic protection system.
293	5.1.1.3	BAT is to implement and maintain operational procedures – e.g. by means of a management system, to ensure that: • high level or high pressure instrumentation with alarm settings and/or auto closing of valves is installed • proper operating instructions are applied to prevent overfill during a tank filling operation, and • sufficient ullage is available to receive a batch filling.
293	5.1.1.3	BAT is to apply leak detection on storage tanks containing liquids that can potentially cause soil pollution. The applicability of the different techniques depends on the tank type.
293	5.1.1.3	BAT for aboveground tanks containing flammable liquids or liquids that pose a risk for significant soil pollution or a significant pollution of adjacent watercourses is to provide secondary containment, such as: • tank bunds around single wall tanks; • double wall tanks; • cup-tanks; • double wall tanks with monitored bottom discharge; For toxic, carcinogenic or other hazardous substances, BAT is to apply full containment.

From the BREF for Refining Oil and Gas

621	49	In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use floating roof storage tanks equipped with high efficiency seals or a fix roof tank connected to a vapor recovery system.
622	51	In order to prevent or reduce emissions to soil and groundwater from the storage of liquid hydrocarbon compounds, BAT is to use one or a combination of technique listed.
622	52	In order to prevent or reduce VOC emissions to air from loading and unloading operations to volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques g below to achieve a recovery rate of at least 95%

Evaluation of MARSA LNG Project

BATs in §5.1.1.3 : The Safety Management system applicable to MARSA LNG Project is described in the Safety Concept which defines the safety requirements and systems to be adopted for the design of the onshore LNG plant facilities –at Sohar Port- in order to protect personnel, environment and assets from threats caused by the production process.
The safety technical barriers implemented in the design proposed shall follow the following principles:

- Strict application (prescriptive) of regulatory requirements and compliance with local laws.
- Application (prescriptive) of the Safety Concept requirements.
- Application (prescriptive) of the COMPANY General Specifications
- Application of a coherent set of Codes & Standards
- Application of good engineering practices of the oil and gas industry.
- Implementation of barriers to prevent re-occurrence of historical major accident hazards of the industry.
- Risk-based definition and implementation of safety technical barriers
- Systematic HSE hazard identification and subsequent risks assessment and management with technical, organisational and human barriers.
- Technological Risks Evaluation and residual risk acceptability verification following COMPANY imposed methodology and criteria, in particular ALARP demonstration phase.

For the BATs in §5.1.1.1, §5.1.1.2, BAT 49,51 & 52 in BREF for Refining of Oil and Gas.

Regarding the LNG storage Tank:

The LNG tank is a full containment tank. The tank shall consist of barriers. The inner tank is primary containment and it shall be capable of holding the net capacity plus the bottom ullage below the Normal Low Liquid Level (NLLL) and additional volume associated with the tank overfill protection. The outer tank shall contain the product vapour for both normal and accidental loads and shall contain the gross capacity of the inner tank under certain specific accidental load conditions. The concrete roof may be provided with curbs under the main pump platform to control the flow of leaking LNG from the tank pump platform. The curbs shall extend along the sides and front of the main pump platform and shall direct the LNG spill to a vertical down-comer to direct the spill to grade. The down-comer shall be sized such that no spills pool on the roof.

The design of the LNG tank is made in order to minimize the heat ingresses in the tank, via the tank walls and the Loading pumps. The tank roof shall be designed to withstand heat radiation / fire exposure in accordance with EN 1473 and Safety Concept.

The gas generated by the heat leaks in the tank, lines and pumps is recovered through the BOG system, where it is permanently measured via a dedicated flowmeter. The gas is compressed with the BOG compressors and sent back to the Liquefaction unit. Liquids in the BOG system are recovered to the LNG rundown line. The gas generated during the loading of a vessel (bunker or LNG carrier) is routed back to the BOG system via a dedicated vapor arms and line to be compressed and sent to the Liquefaction unit.

Regarding the Refrigerant Storage:
The Refrigerant storage are mounded tanks. They are designed according to the characteristics of the fluids to be stored (ethylene, iso-pentane, butane, propane).
The vapors generated in the ethylene bullets are recovered to be used as fuel gas when they are not used as Mixed Refrigerant for the Liquefaction Unit. When not used as fuel gas, the vapors are routed to the flare system to be burnt under control and limit emission of VOC.
During unloading operation from the trucks to the bullets, a connection between the bullet and the tanker is provided to ensure a vapor balance.
The bullets are connected to closed drain system, which consist of the Flare KO drum where the liquids are evaporated with electric heaters and the vapors burned to flare.
The bullets are protected against corrosion with cathodic protection coating. Their inspection is foreseen as per TotalEnergies internal specifications.

Regarding the Nitrogen Storage:
The Nitrogen (GAN and LIN) is provided mainly from the Nitrogen Removal Unit. LIN is stored in dedicated bullets which are fed from the NRU or road tanker. The GAN is mainly provided by the NRU. It can as well be generated from these bullets with vaporizers. And the vapor balance of the bullets is ensured with the GAN consumers and the atmospheric vent located in a safe area.
In case of detection of methane in the LIN produced by the NRU, there is a safety trip to isolate the feed of LIN to the Nitrogen bullets and avoid contamination of the Nitrogen system.

There is no diesel storage as per the BREF definition in the plant. Only daily storage for the consumers (mainly the Fire Water pumps) are installed.

Regarding the toxic fluids
The specifications regarding the toxic substances have been addressed and in compliance with CPY internal specifications. They deal with the design rules such as specific isolation, material, number of connections and avoidance of leaks, drainage and instrumentations. In the PLANT, there is no storage containing toxic fluids as defined by CPY, whether the toxicity is acute or chronic. The BAT is not applicable as such.

Conclusions

The BAT regarding the Storage and the Loading and Unloading system are fulfilled.

Recommendations

The PERC system shall be selected in order to minimise the fugitive emission of VOC during loading operations, the BAT recommends the selection of high integrity equipment from specialized vendors
Potential technological innovation
None identified.

7.10 Unit 10 – Flare

Existing BATs in the BREFs

Page	BAT #	Object
660	55	In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or f non-routine operational conditions (e.g. start-ups, shutdown).
660	56	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the techniques given below: -correct plant design -plant management -correct flaring devices design -monitoring and reporting

Evaluation of MARSA LNG Project

To respect the Zero flaring policy promoted by TotalEnergies, the overall philosophy adopted for the MARSA LNG Project, and as defined in Project documents, is that flaring will be only allowed during start-up, shut down and emergency situations.

The flare headers are swept with nitrogen as a base case, helping to reduce the emissions from the flare, the fuel gas being used in back-up.

The plant will be equipped with tight shut off blowdown valves.

As part of the Performance Monitoring of the plant, referring to the Operating Philosophy, the Plant Managing Systems (ref Unit 1) and CPY practices, the stream of gas from the KO drums to the stacks are measured through dedicated flowmeters.

Conclusions

The BATs related to flare as described in the BREF for Refining of Oil & Gas are fulfilled.

Recommendations

Not applicable

Potential technological innovation

Not applicable.

7.11 Unit 11 – Water Management

Existing BATs in the BREFs		
The BREF – Refining of Oil and Gas states the following BATs regarding the water management		
Page	BAT#	Object
595	BAT 11	In order to reduce water consumption and the volume of contamination water, BAT is to use all of the listed techniques 1. Water stream integration 2. Water and drainage system for segregation of contaminated water streams 3. Segregation of non-contaminated water streams (e.g rainwater) 4. Prevention of spillages and leaks
596	BAT 12	In order to reduce the emission load of pollutants in the wastewater discharge to the receiving water body, BAT is to remove insoluble and soluble polluting substances by using below techniques 1. Removal of insoluble substances by recovering oil (APIs, CPIs, etc) 2. Removal of insoluble substances by recovering suspended solids and dispersed oil (IGFs, sand filtration etc) 3. Removal of soluble substances including biological treatment and clarification
The BAT-associated emission levels for direct water discharges and monitoring frequencies associated are given below,		

Parameter	Unit	BAT-AEL (yearly average)	Monitoring (2) frequency and analytical method (standard)
Hydrocarbon oil index (HOI)	mg/l	0.1 – 2.5	Daily EN 9377- 2 (3)
Total suspended solids (TSS)	mg/l	5 – 25	Daily
Chemical oxygen demand (COD) (4)	mg/l	30 – 125	Daily
BOD_5	mg/l	No BAT-AEL	Weekly
Total nitrogen (5), expressed as N	mg/l	1 – 25 (6)	Daily
Lead, expressed as Pb	mg/l	0.005 – 0.030	Quarterly
Cadmium, expressed as Cd	mg/l	0.002 – 0.008	Quarterly
Nickel, expressed as Ni	mg/l	0.005 – 0.100	Quarterly
Mercury expressed as Hg	mg/l	0.0001 – 0.001	Quarterly
Vanadium	mg/l	No BAT-AEL	Quarterly
Phenol Index	mg/l	No BAT-AEL	Monthly EN 14402
Benzene, toluene, ethyl benzene, xylene (BTEX)	mg/l	Benzene: 0.001 – 0.050 No BAT-AEL for T, E, X	Monthly

(1) Not all parameters and sampling frequencies are applicable to effluent from gas refining sites.
(2) Refers to a flow-proportional composite sample taken over a period of 24 hours or, provided that sufficient flow stability is demonstrated, a time-proportional sample.
(3) Moving from the current method to EN 9377-2 may require an adaptation period.
(4) Where on-site correlation is available, COD may be replaced by TOC. The correlation between COD and TOC should be elaborated on a case-by-case basis. TOC monitoring would be the preferred option because it does not rely on the use of very toxic compounds.
(5) Where total-nitrogen is the amount of total Kjeldahl nitrogen (TKN), nitrates and nitrites.
(6) When nitrification/denitrification is used, levels below 15 mg/l can be achieved.

Evaluation of MARSA LNG Project

There is no so-called process water generated in the train, as there is no water (no free water, and water vapour is negligible) in the feed gas. Only wastewater would be generated from open drains classified in OD1, OD2 and OD3 and from the demineralized water package.

When the demineralized water is generated on site, a side stream of water with brines is produced and routed to the OD2 system.

Permanently contaminated or hazardous open drain (identified as OD1), accidentally oil contaminated open drain (identified as OD2) and oil free open drains (OD3) are segregated with the plant design as guided by TotalEnergies Specifications.

Typically, the permanently contaminated or hazardous collection (OD1) is restricted within the curbed area (e.g chemical spillages, amine spillages in Amine units etc) and transferred for treatment in another facility within the Plant.

The OD2 are recovered in a first flush basin before being treated and transferred to a Third-Party facility (MAJIS) for further treatment to meet the local environmental specifications before disposal.

The specifications provided by MAJIS to be respected by MARSA LNG Project are given below.

Parameter	Unit	Emission Limit
Hydrocarbon oil index	mg/l	Not provided
Total suspended solids	mg/l	30
Chemical oxygen demand	mg/l	200
Biochemical Oxygen Demand	mg/l	20
Total Nitrogen	mg/l	15
Lead	mg/l	0.08
Cadmium	mg/l	0.01
Nickel	mg/l	0.1
Mercury	mg/l	0.001
Vanadium	mg/l	0.1
Phenol Index	mg/l	0.002
BTEX	mg/l	Not provided

It can be noticed than these specifications are less stringent than the associated limits provided in the BAT. However, the water from MARSA LNG Project is to be treated by MAJIS facilities before being discharged to environment. The BAT AELS are not applicable as such to MARSA LNG Project, as no release to the environment of OD1 and OD2 is foreseen..

Conclusions

The Plant design is in line with the BAT recommendation regarding the water management techniques for natural gas plants.
Recommendations
Not applicable.
Potential technological innovation
Not applicable

7.12 Unit 12 – Other Utilities

Existing BATs in the BREFs
The BREF for energy Efficiency in "Energy-Using" state in BAT 28 the four recommendations regarding lighting described below: ▪ Assessment of the lightning needs and priorities. ▪ Optimization of the natural light use: by design of installations but also planning of activities. ▪ Selection of fixtures and lamps according to specific requirements for the intended use. ▪ Use of lighting management control systems including occupancy sensors and timers. The same BREF provides the following recommendation in BAT 27 regarding HVAC: ▪ Ventilation: use fans of high efficiency and designed to operate at optimal rate. ▪ Optimization of electric motors and considers installing a VSD. ▪ Use automatic control systems. Integrate with centralized technical management systems. ▪ Integration of air filters into air duct system and heat recovery from exhaust air (heat exchangers). Reduce heating/cooling needs by building insulation, efficient glazing, air infiltration reduction, automatic closure of doors, lowering of temperature set point during non-production period (programmable regulation), reduction of the set point for heating and raising it for cooling
Evaluation of MARSALNG Project
The MARSA Plant design shall follow the COMPANY general specification related to Environmental Requirements for Projects Design stating that Lighting should be reduced to the minimum and directed in such a way so as to limit nuisance to the surrounding communities and to avoid to attract animals (such as birds or turtles). The selected technology is LED, as required by electrical COMPANY General Specifications, supporting the reduction of energy consumption. In term of Heating Ventilation and Air Conditioning, the MARSA LNG Project has develop a dedicated specification on top of the CPY general specification with the building minimum requirements to be respected. For instance, the cooling capacities of the buildings shall be put in common in order to: • Minimize the number of equipment, • Reduce the installed cooling capacity, • Reduce the electrical consumption, • Minimize the refrigerant quantities handled and the possible environmental impact, • Maximize the availability. Finally, MARSA LNG Project shall comply to CPY general specification specifying the minimum requirements for building design and the green building concept aligned with BAT principles.
Conclusions

The lighting is in line with BAT recommendations. The HVAC system will have to be developed in line with project requirements to ensure that the BAT recommendation is fulfilled.
Recommendations
For the next phase of the project, the HVAC equipment design should focus on BAT points such as: installation of VSD on electric motors when applicable, building insulation, efficient glazing, air infiltration reduction, automatic closure of doors, lowering of temperature set point during non-production period (programmable regulation), reduction of the set point for heating and raising it for cooling
Potential technological innovation
Not applicable.

7.13 Unit 13 - Monitoring

Existing BATs in the BREFs		
The BREF on Refining of Oil and Gas provides the following BATs relevant to Monitoring and Reporting		
Page	BAT#	Object
610	BAT 4	BAT is to monitor emissions to air by using the monitoring techniques with at least the minimum frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards, that ensure the provision of data of an equivalent scientific quality.

Description	Process unit	Minimum frequency	Monitoring technique
i. SO_X, NO_X, and dust emissions	Catalytic cracking	Continuous (1) (2)	Direct measurement
	Combustion units ≥ 100 MW (3) and calcining units	Continuous (1) (2)	Direct measurement (4)
	Combustion units of 50 to 100 MW (3)	Continuous (1) (2)	Direct measurement or indirect monitoring
	Combustion units <50 MW (3)	Once a year and after significant fuel changes (5)	Direct measurement or indirect monitoring
	Sulphur recovery units (SRU)	Continuous for SO_2 only (2)	Direct measurement or indirect monitoring (6)
ii. NH_3 emissions	All units equipped with SCR or SNCR	Continuous	Direct measurement
iii. CO emissions	Catalytic cracking and combustion units ≥ 100 MW (3)	Continuous	Direct measurement
	Other combustion units	Once every 6 months (5)	Direct measurement

(1) Continuous measurement of SO_2 emissions may be replaced by calculations based on measurements of the sulphur content of the fuel or the feed; where it can be demonstrated that this leads to an equivalent level of accuracy.
(2) Regarding SO_X, only SO_2 is continuously measured, while SO_3 is only periodically measured (e.g. during calibration of the SO_2 monitoring system).
(3) Refers to the total rated thermal input of all combustion units connected to the stack where emissions occur.
(4) Or indirect monitoring of SO_X.
(5) Monitoring frequencies may be adapted if, after a period of one year, the data series clearly demonstrate a sufficient stability.
(6) SO_2 emissions measurements from SRU may be replaced by a continuous material balance or other relevant process parameter monitoring, provided appropriate measurements of SRU efficiency are based on periodic (e.g. once every 2 years) plant performance tests.

Page	BAT#	Object
	BAT 5	BAT is to **monitor the relevant process parameters** linked to pollutant emissions, at catalytic cracking and combustion units by using appropriate techniques and with at least the frequency given

Description	Minimum frequency
Monitoring of parameters linked to pollutant emissions, e.g. O_2 content in flue-gas, N and S content in fuel or feed ([1])	Continuous for O_2 content. For N and S content, periodic at a frequency based on significant fuel/feed changes

([1]) N and S monitoring in fuel or feed may not be necessary when continuous emission measurements of NO_X and SO_2 are carried out at the stack.

	BAT 6	BAT is to **monitor diffuse VOC emissions** to air from the entire site by using all of the following techniques 1. Sniffing methods associated with correlation curves for key equipment 2. Optical gas imaging techniques 3. Calculations of chronic emissions based on emissions factors periodically (e.g once every two years) validated by measurements The screening and quantification of site emissions by periodic campaigns with optical absorption-based techniques, such as differential adsorption light detection and ranging (DIAL) or solar accultation flux (SOF) is a useful complementary technique.

Regarding monitoring, IED 2015/2193, Annex III states, that

1. Periodic measurements shall be required at least:

— every three years for medium combustion plants with a rated thermal input equal to or greater than 1 MW and less than or equal to 20 MW,

— every year for medium combustion plants with a rated thermal input greater than 20 MW.

2. As an alternative to the frequencies referred to in point 1, in the case of medium combustion plants which are subject to Article 6(3) or Article 6(8), periodic measurements may be required at least each time the following numbers of operating hours have elapsed:

— three times the number of maximum average annual operating hours, applicable pursuant to Article 6(3) or Article 6(8), for medium combustion plants with a rated thermal input equal to or greater than 1 MW and less than or equal to 20 MW,

— the number of maximum average annual operating hours, applicable pursuant to Article 6(3) or Article 6(8), for medium combustion plants with a rated thermal input greater than 20 MW.

The frequency of periodic measurements shall in any case not be lower than once every five years.

3. Measurements shall be required only for:

(a) pollutants for which an emission limit value is laid down in this Directive for the plant concerned;

(b) CO for all plants.

Evaluation of MARSA Project

MARSA project shall fulfil the TotalEnergies Company Rule detailing the rules to be applied by the Field Operation Representative of the MARSA LNG Project regarding the metering of the fluids and effluents flowing through the Plant. The Metering& Allocation Philosophy describes the metering principles and the “constrains” to be considered. In terms of environment, Equipment and/or methods to determine Emissions such as gas flaring and liquid discharges must agree with latest version of Oman Guidelines. If they don’t exist International standards such as OIML or other National standards recognised by the LNG Industry should be applied to permit to verify the compliance of the metering equipment’s at all the project phases (design, installation, commissioning) and during the operations. The type of metering (fiscal or technical) will have to be detailed. In terms of emission, the following points are identified at this stage of the project: • Fired heater for (heating medium) • Boil of gas Compression • Gas Flaring • AGRU • NRU A laboratory will permit to carry out the analysis coming from the different samplings associated to the metering systems (Feed gas, AGRU, Condensate export, LNG rundown and storage, water feed and waste and fuel gas).
Conclusions
The project is in line with the BAT regarding the implementation of metering management in the Plant.
Recommendations
The Metering Philosophy should detail the frequency of measurement of the different elements as per BAT 4. An Operating Procedure dedicated to Laboratory Sample schedule defining the frequency of measurement should be developed during the next phase of the project. Monitoring of diffuse VOC emissions should be reviewed during the next phase of the project and identified in the Operating Procedures.
Potential technological innovation
Not applicable

8. CONCLUSION

The MARSA LNG Project is based on an energy efficient and zero emissions design and operating philosophy. The design and the technological choices made during the FEED show the commitment to achieve a high environmental performance.

In this report the technical choices have been evaluated with the Best Available Techniques from an EU regulation perspective. All the units studied match the Best Available Techniques for energy efficiency. Recommendations have been detailed in each unit's assessment. They are related to selection of equipment or operating philosophy to be done in the next phases of the project.

With the level of details available, all the Units match the BAT concept from the IED. During the next phase of the Project, design and Operating requirements and specification will be implemented to confirm BAT appliance.

The table below summarizes the main conclusion of this report.

MARSA selected Units		BAT @ FEED	Comments / Recommendations
Unit 1	Energy Efficiency at Installation Level	Fulfilled	▪ Operating manuals will have to detail how an Energy Efficient Management System shall be implemented as well as the specific training to personnel. ▪ Detailed design of the MARSA LNG Project shall respect the high requirement level in term of availability and robustness. ▪
Unit 2	Acid Gas Thermal Oxidiser	Partially Fulfilled	Regarding the SOx, the BAT is not fully fulfilled if focusing only on the SOx emissions to air. However, the study of the different abatement techniques concludes that the environmental impact would increase significantly. Therefore, the technique implemented by the MARSA LNG Project can be considered as the most effective in term of overall impact.
Unit 4	Warm End	Fulfilled	
Unit 5	Nitrogen Removal Unit	Fulfilled	
Unit 6	Heat Exchangers	Fulfilled	The BAT for Industrial Cooling System is not fully fulfilled. However, it shall be noted that the BREF is mainly applicable to water- or air-cooling towers, applied for larger looing duty than the MARSA LNG Project. It shall be noted that compared to the overall power demand of the PLANT, the air coolers account for less than 1%. Therefore, the energy efficiency loss can be considered very marginal

Unit 7	Power Supply and Electric Motors	Fulfilled	
Unit 8	Liquid Pumping Systems	Fulfilled	
Unit 9	Loading, Unloading and Storage	Fulfilled	The PERC system shall be selected in order to minimize the fugitive emission of VOC during loading operations, the BAT recommends the selection of high integrity equipment from specialized vendors
Unit 10	Flare	Fulfilled	
Unit 11	Water Management	Fulfilled	
Unit 12	Other Utilities	Partially Fulfilled	For the next phase of the project, the HVAC equipment design should focus on BAT points such as: installation of VSD on electric motors when applicable, building insulation, efficient glazing, air infiltration reduction, automatic closure of doors, lowering of temperature set point during non-production period (programmable regulation), reduction of the set point for heating and raising it for cooling
Unit 13	Monitoring	Fulfilled	The Metering Philosophy should detail the frequency of measurement of the different elements as per BAT 4. An Operating Procedure dedicated to Laboratory Sample schedule defining the frequency of measurement should be developed during the next phase of the project. Monitoring of diffuse VOC emissions should be reviewed during the next phase of the project and identified in the Operating Procedures.

APPENDIX A – BAT EVALUATION FOR SULPHUR RECOVERY IN ACID GAS

I. INDUSTRIAL EMISSIONS DIRECTIVE

The Industrial Emissions Directive 2010/75/EU is the main EU instrument regulating pollutant emissions from industrial installations. It aims to achieve a high level of protection for human health and the environment taken as a whole by reducing the harmful industrial emissions, in particular through better application of Best Available Techniques (BAT). IED is based on

a) Integrated approach means that the environmental permits must take in to account the whole environmental performance of the plant, covering e.g emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents and restoration of the site upon closure.
b) The emission limit values must be based on the Best Available Techniques (BAT). BAT reference documents (BREF) provides the expertise in defining the BAT and BAT associated environmental performance, and the BAT conclusions are adopted as implementing decisions. IED 2010/75/EU defines the Best Available Techniques as "the most effective techniques for preventing or reducing emissions that are technically feasible and economically viable within the sector".

The BAT study for Sulphur recovery from acid gas for MARSA LNG Bunkering project assesses the design options, and ultimate use of technology and operating practices (for the cases where technology has been decided), that provide the least impact to the environment.

II. BAT EVALUATION METHODOLOGY

The Best Available Technologies evaluation are performed by using the BAT Guidewords from Annex III of the Industrial Emissions Directive 2010/75/EU, as given in table below,

Table 1- Criteria for determining best available techniques

1	Use of low-waste technology	7	The commissioning dates for new and existing installations.
2	Use of less hazardous substances	8	The length of time needed to introduce the best available technique.
3	Recovery and recycling of substances generated and used in the process and of waste, where appropriate.	9	The consumption and nature of raw materials (including water) used in process and their energy efficiency.
4	Comparable processes, facilities and methods of operation which have been tried with success on an industrial scale.	10	The need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it.
5	Technological advances and changes in scientific knowledge and understanding.	11	The need to prevent accidents and to minimize the consequences to the environment.
6	The nature, effects and volume of the emissions concerned.	12	The information published by public international organizations

III. TECHNOLOGIES EVALUATION

A. BACKGROUND

The general overview of the MARSA LNG Project, is given in below diagram.

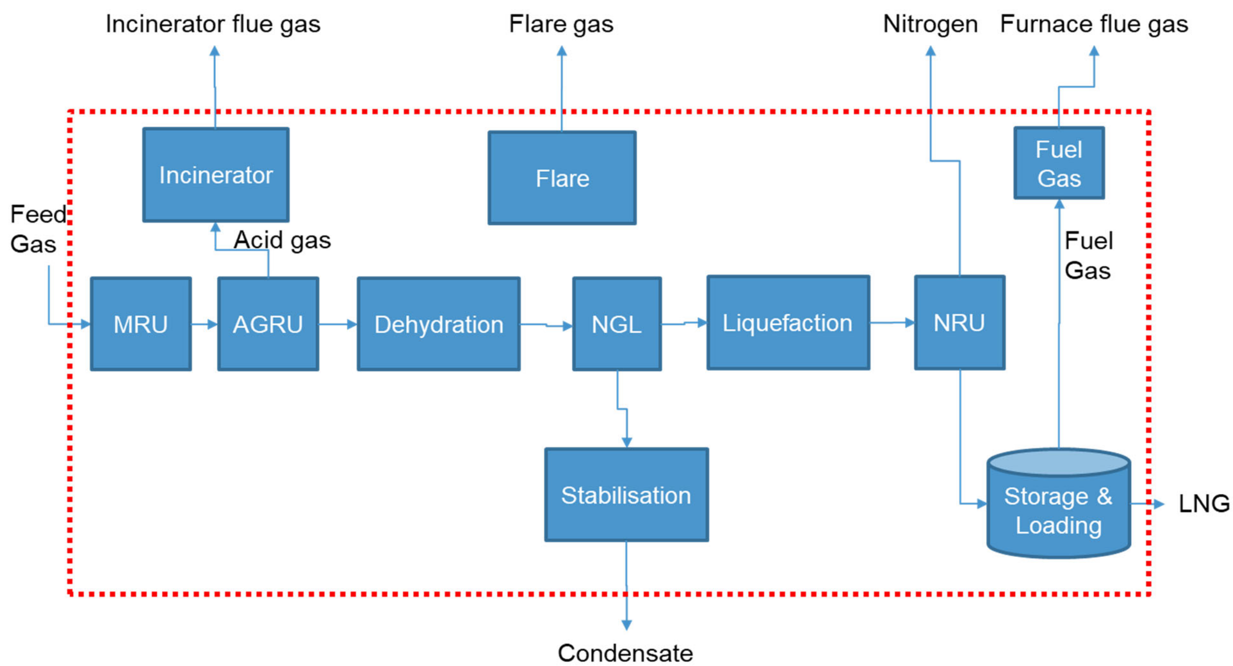


FIGURE A 8-1 – MARSA LNG BUNKERING PLANT OVERVIEW

MARSA LNG plant is designed to handle a maximum flow of 158 MMSCFD gas from pipeline. The feed gas design & expected compositions are as in Table 2 below.

Table 2- FEED GAS COMPOSITION

Component	Composition 1 – Highest CO2 (% mol) [Design Case]	Composition 2 – Highest N2 (% mol) [Design Case]	Expected Composition [Mean Value from Gas Supply Station Samples] [A]
Water	0	0.01	0.01
Nitrogen	1.87	6.3	4.16
Carbon Dioxide	1.67	0.17	1.03
Methane	91.13	93.41	87.93
Ethane	3.35	0.11	4.27
Propane	1.11	0	1.65
i-Butane	0.28	0	0.31
n-Butane	0.32	0	0.4
i-Pentane	0.10	0	0.1
n-Pentane	0.18	0	0.09
H2S[B]	Max. 5 ppmv	Max. 5 ppmv	2 ppmv
Mercaptan[B]	Max. 5 ppmv	Max. 5 ppmv	0.1 ppmv
Total Sulphur[B]	Max. 5 ppmv	Max. 5 ppmv	2 ppmv
Benzene	100 ppmv	-	90 ppmv

[A] Mean Average of 3 given samples collected at Gas Supply Station (GSS). H2S & Mercaptan are the max values observed within samples.

[B] The value of max 5 ppmv is given in the pipeline specifications.

While the main objective of the AGRU is to remove the CO_2 in the feed gas to meet the stringent specification for the downstream cryogenic units, the H_2S & Mercaptan in the feed gas are also removed into the acid gas stream from AGRU regenerator overhead as indicated in the Figure below.

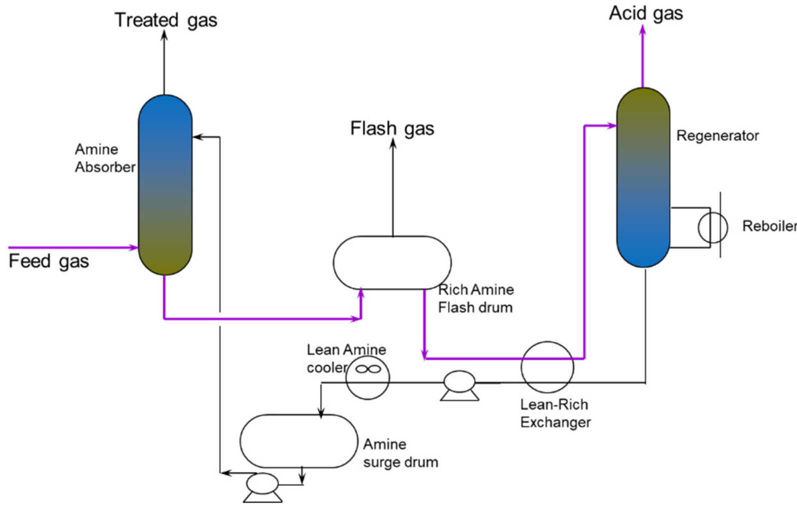


Figure 5 - ACID GAS REMOVAL UNIT OVERVIEW

B. ACID GAS STREAM COMPOSITION AT DESIGN AND EXPECTED CONDITIONS

Based on the design and expected feed gas composition indicated above, the acid gas from the AGRU regenerator reflux drum overhead is, as below.

Table 3- ACID GAS STREAM FROM AGRU

		Composition 1 – Acid Gas (% mol) [1]	Composition 2 – Acid Gas (% mol) [1]	Expected – Acid Gas (% mol) [3]
Pressure	Barg	0.9	0.9	0.9
Temperature	°C	50.9	50.9	50.9
Mass flow	Kg/hr	6153	693	3689
Mol Wt	Kg/kmol	42.18	41.51	41.98
Molar Composition				
CO2	% mol	92.9119	90.3496	91.981
Water	% mol	6.6137	6.5993	6.6268
Nitrogen	% mol	0.0009	0.0187	0.0034
Methane	% mol	0.3904	2.7839	0.8248
Ethane	% mol	0.0397	0.0099	0.5301
Propane	% mol	0.0037	0.0000	0.0057
n-Butane	% mol	0.0002	0.0000	0.0000
n-Pentane	% mol	0.0002	0.0000	0.0000
n-Hexane	% mol	0.0000	0.0000	0.0000
n-Heptane	% mol	0.0002	0.0033	0.0000
iso-Butane	% mol	0.0003	0.0000	0.0000
Benzene	% mol	0.0117 [2]	0.0000	0.0103
H2S	% mol	0.0270	0.2353	0.0179

[1] The values from HMB (stream 121) provided by AGRU Licensor

[2] Benzene concentration can be upto 1000 ppmv

[3] Acid Gas composition for the expected feed gas composition as referred in Table 2

It can be noted from the Table above for the Composition 1 & 2, the maximum acid gas flow and associated H_2S concentration are based on Max. 5 ppmv of H_2S in feed gas at 158 MMSCFD (design case) and 100% of H_2S in feed gas are removed into acid gas stream by AGRU unit. The expected composition, the acid gas flow and associated H_2S concentration is estimated based on 2 ppmv of H_2S in feed gas at 158 MMSCFD.

In order to reduce the H_2S, VOC (Hydrocarbons and Benzene) emissions to atmosphere, vapor destruction (incineration through thermal oxidisation) is considered in the design as minimum requirement. The thermal oxidiser can ensure complete conversion of H_2S into SO_2 and complete destruction of Hydrocarbons and Benzene.

Hence thermal oxidisation is considered within FEED design and addressed as base case design in this document.

C. EXPECTED EMISSIONS FROM THERMAL OXIDISATION

With the thermal oxidisation to incinerate the H_2S & VOCs with the acid gas stream, the expected emission concentration in the thermal oxidiser effluent for the design and expected conditions are as below.

Table 4- EMISSIONS FROM THERMAL OXIDISATION

Pollutant	**Composition 1 – Thermal Oxidiser Exhaust**		**Composition 2 – Thermal Oxidiser Exhaust**		**Expected – Thermal Oxidiser Exhaust**	
	Concentration mg/Nm3 [2]	*Flowrate Ton/year* [2]	*Concentration mg/Nm3* [2]	*Flowrate Ton/year* [2]	*Concentration mg/Nm3* [2]	*Flowrate Ton/year* [2]
Particulate	Neg [1]	Neg [1]	Neg [1]	Neg [1]	Neg [1]	Neg [1]
H2S	-	-	-	-	-	-
SO2	275	20.95 [5]	2450	20.95 [5]	135 [7]	6.26 [5] [7]
CO	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
CO2		54950 [5] [6]		6800 [5] [6]		33395 [5] [6]
HC	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
NOx	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]	Neg [3]
Benzene	Neg [4]	Neg [4]	Neg [4]	Neg [4]	Neg [4]	Neg [4]

[1] No particulate emission envisaged as feed & fuel are gaseous.

[2] The values are estimated based on the flue gas factor of 1500 Nm3 (dry basis)/t of Acid gas feed in section 8.6.2 (BREF Refining). This is considered as conservative approach in estimation of flue gas.

[3] CO, unburnt HC & NOx content in flue gas is managed by combustion controls. To be confirmed with vendor feedback.

[4] Benzene destruction efficiencies are expected to be >99.9% and hence no concentration expected. To be confirmed with vendor feedback.

[5] Based on 95% plant availability.

[6] CO2 emission factor of 2.49 kg CO2 /kg of fuel gas considered.

[7] Expected SO2 emission concentration and quantity based on pipeline lab samples collected and 75% H2S absorption efficiency in AGRU.

Based on the design specification of Max. 5 ppmv H2S with 158 MMSCFD of feed gas (equivalent to 30 kg/day as Elemental Sulphur), the SO_2 emission quantity remain constant at 20.9 tons/year between composition 1 & 2. However, the SO_2 emission concentration varies between composition 1 & 2, based on the CO_2 content in feed which acts as diluents.

It should be noted that the SO_2 emission quantity is reduced by 40% based on expected specification of Max. 2 ppmv H2S with 158 MMSCFD of feed gas (& 1% CO2). Also, based on AGRU Licensor feedback, only up to 75% of H_2S is expected to be removed in AGRU into acid gas to thermal oxidiser. Hence, SO_2 emission quantity in thermal oxidiser exhaust are envisaged to be reduced to 30% (.75 x 2 / 5), i.e SO_2 emission quantity to 6.3 ton/yr.

D. ENVIRONMENTAL EMISSION LIMITS FOR BAT ASSESSMENT

The emission limits provided with Omani Decree MD118/2004 for section 11 petroleum works is observed to be very relevant for MARSA LNG plant in-line with associated emission limits been discussed under BREF Refining of Oil and Gas (under Natural Gas Plant). Hence the following were derived as project emission limits related to Sulphur pollutants during the FEED studies.

Table 5- EMISSION LIMITS DURING FEED STUDIES

Pollutants	***Unit***	**MD118 9 - Incineration Works**	**MD 118 11 Petroleum Works**	**TOTAL Marsa LNG PLANT Thermal Oxidiser** *(During FEED studies)*
Carbon Monoxide	*g/Nm3*	-	-	0.100
Carbon Dioxide	*g/Nm3*	-	-	-
Hydrogen Sulphide	*ppmv*	5	5	5
Unburnt hydrocarbons	*g/Nm3*	-	-	-
Nitrogen Oxides (@ Nitrogen Dioxide)	*g/Nm3*	0.200	-	0.100
Sulphur Dioxide	*g/Nm3*	-	-	0,02 [1]
VOCs	*g/Nm3*	-	0.035	0,02
Total particulates	*g/Nm3*	0.050	0.100	0.100
Sulphur recovery efficiency	*%*	-	99.9	[1]
Benzene	*g/Nm3*	-	-	0,001
Oxygen	*%*	-	-	-

[1] this stringent specification on SO2 and associated Sulphur recovery efficiency were considered during FEED studies.

While TotalEnergies have committed to reduce overall environmental impact to atmosphere from the MARSA LNG plant, it is imperative to evaluate the best available techniques (BAT) for sulphur recovery & abatement along with its technical & commercial feasibility and cross media impact while meeting this emission limits. Hence, TotalEnergies have initiated the BAT Evaluation of sulphur recovery & abatement techniques which are addressed in following sections.

E. TECHNIQUES FOR SULPHUR RECOVERY QUALITATIVE ASSESSMENT

Within BREF for Refining under Natural gas plant applications, no associated emission limits for vapor destruction technique (Thermal oxidation) with respect to SOx emissions to air are indicated.

However, for sour feed gases, based on the Sulphur content with the acid gas, **BAT 54** identifies the available sulphur recovery techniques (primary or process related technique) and associated environmental performance level with the techniques under section 5.17 & section 5.20.3 within BREF Refining as below.

1. Sulphur recovery units (SRU) e.g by Claus process
2. Tail gas treatment units (TGTU), in specific,
    a. Recovering sulphur from H2S (e.g Liquid REDOX)

b. Recovering sulphur from SO2 (e.g caustic, lime scrubbing)

It should be noted that there is no associated emission levels (AEL) indicated with these BAT but associated environmental performance levels (AEPL) for waste gas sulphur recovery (H2S) system been provided as 99.5 to 99.9% with new sulphur recovery units (>98.5% for existing sulphur recovery units).

In addition to the above sulphur recovery techniques, there are other sulphur abatement techniques addressed within BREF – Refining. The consolidated list of techniques, which are qualitatively reviewed are, as below.

Table 6- LIST OF SULPHUR RECOVERY / REMOVAL TECHNIQUES

Sulphur abatement technique	Pretreatment - Sulphur Recovery	Pretreatment – Sulphur Removal	Post-treatment – sulphur Recovery	Post-treatment – sulphur Removal	Reference
Sulphur Recovery Process (SRU)	Yes				BREF REF 4.23.5.2.1
Tail gas treatment units -LO-CAT process	Yes				BREF REF 4.23.5.2.2.3
Tail gas treatment units -Wellman-lord (WL)			Yes		BREF REF 4.23.5.2.2.4
Tail gas treatment units -LABSORB			Yes		BREF REF 4.23.5.2.2.4
Solid Scavenger	-	Yes	-		BREF REF 4.23.5.3
Wet Gas Scrubbing of the Acid Gas (Cansolv technology)			Yes		BREF REF 4.23.5.2.3
Wet Gas Scrubbing of the Acid Gas (seawater scrubber)	-			Yes	BREF REF 4.23.5.2.3
Wet Gas Scrubbing of the Acid Gas (Magnesium based)	-			Yes	BREF REF 4.23.5.2.3
SO2 abatement technique Spray dry absorber (SD)				Yes	BREF REF 4.23.5.4
SO2 abatement technique Walther (WA)				Yes	BREF REF 4.23.5.4
SO2 abatement technique Wet limestone scrubber (WS)				Yes	BREF REF 4.23.5.4
SO2 abatement technique Waste Gas Sulphuric acid (WSA)			Yes		BREF REF 4.23.5.4
Caustic Wet Scrubbing			Yes		BREF REF 4.23.5.2.3

F. QUALITATIVE ASSESSMENT OF SULPHUR ABATEMENT TECHNIQUES

With the H_2S concentration as reflected in Table 3 and maximum of 0.03 tons per day of sulfur to recover (Design case), it can be observed that scavengers (non-regenerative) are the only possible process option based on the typical Sulphur recovery process selection chart.

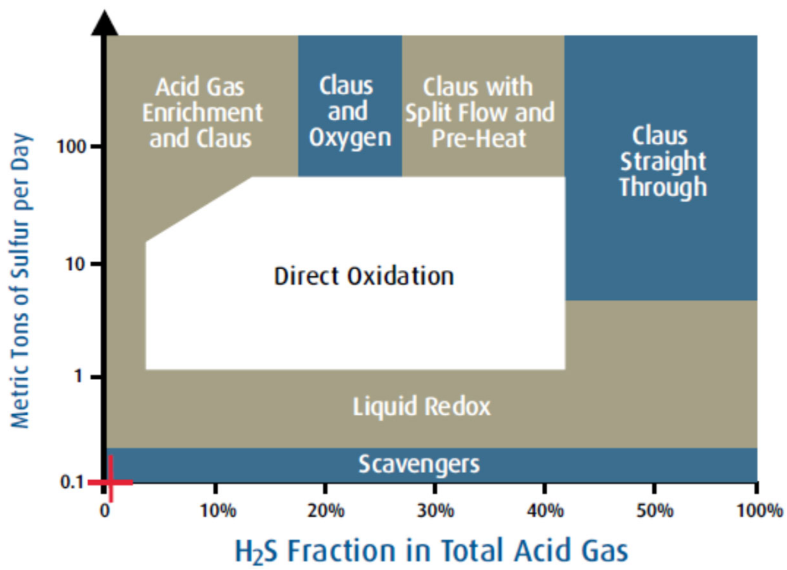


Figure 6- TYPICAL SULPHUR RECOVERY PROCESS APPLICATION RANGE CHART
(source: BREF for Refining)

It should be noted that through scavengers, the Sulphur into value added product and hence they are considered as Sulphur removal technique.

A qualitative evaluation of the available techniques identified in Table 6 , with the criteria presented in Table 1 to reduce emissions of SOx are studied with the information within BREF Refining and the results can be referred with the qualitative assessment table in Attachment 1.

The results of the assessment are summarized as below table.

Table 7- Qualitative Assessment Results of the Sulphur Recovery and removal technique

	Techniques	Qualitative evaluation [1]	Remarks
Post treatment	Seawater Scrubbing	3	sea water return at high pH and localized acidification impact
	Caustic Wet Scrubbing	2	High CAPEX, large footprint
	Limestone wet scrubbing	2	Gypsum solid handling required Similar technology as Caustic.
	Magnesium hydrate	2	Similar technology as Caustic
	Ammonium Sulfate Recovery	2	Similar technology as Caustic
	Spray Drying	3	Impossible to achieve 0.02g/m3. Gypsum solid handling required Similar technology as Caustic.
	Wellman-Lord	3	Not possible to handle waste SO2
	Labsorb	3	Not possible to handle waste SO2
	Cansolve	3	Not possible to handle waste SO2
Pre-treatment	Scavenger	1	Small CAPEX and footprint
	SRU	2	Sulfur handling required.
	WSA	3	High CAPEX, large footprint

[1] 1 – Good; 2 – Acceptable; 3 – Not acceptable

From the above qualitative assessment, the following can be inferred:

1. Of the 12 techniques reviewed, only scavenger can be considered as good, and 5 techniques as acceptable.
2. Of the non-regenerative wet scrubbing techniques identified (Caustic, Limestone, Magnesium and Ammonium sulfate), caustic wet scrubbing is most common technique. This is further evaluated with BAT guidewords in the following section.
3. The only Sulphur recovery process identified in the quantitative assessment is mini SRU (LO-CAT process). However, there is no reference for handling H_2S concentrations in fractions (<0.3%) and sulphur recovery less than 0.5 MTPD of sulphur [Reference: Fundamentals of Low-Tonnage Sulfur Removal and Recovery, Laurance Reid Gas Conditioning Conference, 2017]. This is also confirmed by Merichem (Licensor for LO-CAT process)

4. Sulphur removal through scavengers are the economically acceptable option (small CAPEX and footprint).
5. **It should be noted that no Sulphur recovery process is observed to be feasible or economically viable for the design and expected operating conditions with Marsa LNG plant.**

G. BAT EVALUATION FOR SULPHUR REMOVAL

Of the various sulphur recovery & removal techniques qualitatively assessed, the following techniques are shortlisted to be further reviewed with the criteria identified within Annex III of IED Directive 2010/75/EU. They are:

1. Thermal Oxidizer (Vapor destruction technique) with no Sulphur removal – Base case considered in this Appendix
2. Scavenger for sulphur removal followed by Thermal Oxidizer (Two sub options: one with H2S removal and one with complete removal of H2S and Mercaptan.
3. Thermal Oxidizer + Post treatment (caustic scrubbing) for SOx removal

The shortlisted techniques have been evaluated per equipment type, following the BAT guidewords from IED, as in the table below.

Table 8- BAT Evaluation Results

			Thermal Oxidizer (BASE CASE)	Sulphur removal by pre-treatment + Thermal Oxidizer		Sulphur removal - Thermal oxidizer + Post treatment (Caustic scrubbing)
			No Sulphur Removal	H2S removal only	H2S + Mercaptan removal	SO_2 removal
Criteria for determining best available techniques from Appendix III of DIRECTIVE 2010/75/EU	1	Use of low-waste technology.	(+) Besides the SO2, GHG emissions due to combustion of fuel gas, no other waste is generated.	(-) Besides the SO2 & GHG emissions (due to fuel gas combustion), limited amount of spent sorbent (min. 32 ton/year) with upto 35% wt S.	(-) Besides the SO2 & GHG emissions (due to fuel gas combustion), limited amount of spent sorbent (min. 85.2 ton / year) with upto 35% wt S and 4% wt Mercaptan.	(-) Besides the SO2 & GHG emissions (due to fuel gas combustion), Waste water to the magnitude of 43800 m3/yr is generated.
	2	Use of less hazardous substances.	(+) No hazardous substances. Only fuel gas at pipeline or BOG specification utilized for incineration.	(-) The fresh sorbent is not flammable, toxic or pyrophoric. However the spent sorbent containing adsorbed H2S can be hazardous. Hazardous material handling envisaged every year upto 2 days.	(-) The fresh sorbents are simple iron based sorbent and are non flammable, toxic or pyrophoric. However, the spent sorbent containing adsorbed H2S can be hazardous. Hazardous material handling envisaged every year upto 5 days.	(-) Neutralization of the waste water will require hazardous acid handling (HCL)
	3	Recovery and recycling of substances generated and used in the process and of waste, where appropriate.	NA	(-) Recovery of spent sorbent will result in concentrated emission to atmosphere. Recycling not possible. Expected to be stabilised and sent to landfill site	(-) Recovery of spent sorbent will result in concentrated emission to atmosphere. Recycling not possible. Expected to be stabilized and sent to landfill site	(-) Recycling limited by concentration of spend caustic solution. Generally, continuous liquid effluent waste generation.
	4	Comparable processes, facilities and methods of operation which have been tried with success on an industrial scale.	(+) Well proven technology	(+) Well proven technology	(-) Less references for mercaptan removal	(+) Well proven technology
	5	Technological advances and changes in scientific knowledge and understanding.	(+) Well proven technology	(+) Well proven technology	(-) Less references for mercaptan removal	(+) Well proven technology
	6	The nature, effects and volume of the emissions concerned.	(-) SO_2: ~21 ton/year (air emission)	(-) SO_2: ~3 ton/year (in air emission) 17.9 ton/year of SO2 removed as solid waste to Land fill along with spend catalyst	(-) SO_2: ~1 ton/year (in air emission) 19.9 ton/year of SO2 removed as solid waste to land fill along with spend catalyst.	(-) SO_2: ~1 ton/year in air emission. 19.9 tons/year of SO2 absorbed in caustic solution which has to be neutralized for pH, filter pressed to meet turbidity, suspended solids etc in liquid effluent before discharge to battery limit.
	7	The commissioning dates for new and existing installations.	NA	NA (Greenfield)	NA (Greenfield)	NA (Greenfield)
	8	The length of time needed to introduce the best available technique.	NA	NA (Greenfield)	NA (Greenfield)	NA (Greenfield)
	9	The consumption and nature of raw materials (including water) used in process and their energy efficiency.	(+) Fuel Gas consumption ~ 255 kg/h	(-) Fuel Gas consumption ~ 255 kg/h. Also, 32 ton/year of H2S removal sorbent catalyst. Additional heat tracing requirement not quantified.	(-) Fuel Gas consumption ~ 255 kg/h. Also, 85 ton/year of sorbent catalyst which include 32 tons for H2S removal, 11.5 tons/year for Disulphide converter and 41.7 tons for Mercaptan removal. Additional heat tracing requirement not quantified.	(-) Fuel Gas consumption ~ 255 kg/h. Other consumptions are caustic solution, acid solution, water. Significant consumption of electricity for the scrubber pump, oxidation blower, agitation, neutralization etc depending on configuration.
	10	The need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it.	(+) Lowest emissions to environment overall	(-) Overall impact negative (more effluent generated by the production and treatment of sorbents than SOx emitted without treatment)	(-) Overall impact negative (more effluent generated by the production and treatment of sorbents than SOx emitted without treatment)	(-) Expected overall impact negative (more emissions generated by the production of raw materials, treatment of effluents)
	11	The need to prevent accidents and to minimize the consequences to the environment.	(+) Simple process, minimum operator intervention. Operational risk to environment minimal.	(-) Simple process, minimum operator intervention outside of sorbent change out. Operational risk to environment minimal.	(-) Simple process, minimum operator intervention outside of sorbent change out. Operational risk to environment minimal.	(-) Complex unit: continuous neutralization and sludge handling. Potential for leakage of wastes to the environment.
	12	The information published by public international organizations	NA	EU IED Directive 2010/76/EU. BREF for Refining of Oil and Gas	EU IED Directive 2010/76/EU. BREF for Refining of Oil and Gas	EU IED Directive 2010/76/EU. BREF for Refining of Oil and Gas

n addition, the cross-media impact assessment of the options are addressed in the table below.

Table 9- Cross Media Impact Summary

		Thermal Oxidizer (BASE CASE)		Sulphur removal by pre-treatment + Thermal Oxidizer				Sulphur removal - Thermal oxidizer + Post treatment (Scrubbing)
		No Sulphur Removal		H2S removal only		H2S + Mercaptan removal		SO_2 Removal
Emissions		SO_2: ~21 ton/year, GHG emissions		SO_2: ~3 ton/year, GHG emissions		SO_2: ~1 ton/year, GHG emissions		SO_2: ~1 ton/year, GHG emissions
Consumptions		1. Fuel Gas consumption ~ 255 kg/h		1. Fuel Gas consumption ~ 255 kg/h 2. Utilities: [A] electricity for heat tracing Raw material: 48 ton/year (simple chemical sorbent)		1. Fuel Gas consumption ~ 255 kg/h 2. Utilities: [A] electricity for heat tracing Raw material: 120 ton/year (simple chemical sorbent + iron-based sorbent + mesoporous carbon sorbent with surface functional groups)		1. Fuel Gas consumption ~ 255 kg/h 2. Utilities: [A] electricity for pumps, water (5t/h) Raw materials: Caustic soda (5kg/h) or limestone or ammonia
Wastes		NA		32 ton year of spent sorbent + sorbent treatment (stabilization + disposal)		85 ton /year of spent sorbent + sorbent treatment (stabilization + disposal)		Waste water (43800m3/year), or gypsum, or ammonium salt solution
Overall Environmental effect		Acidification Global Warming		Acidification (less), Global Warming + sorbent treatment (stabilization + disposal as land fill)		Acidification (less), Global Warming + More Sorbent treatment (stabilization + disposal as land fill).		Acidification (less), Global Warming + Sludge generation (disposal to land fill) + Liquid Effluent pH, Turbidity and COD treatment required.
CAPEX		BASE CASE		BASE CASE + $0.93 Millions [B]		BASE CASE + $3.2 Millions [B]		BASE CASE + $5 Millions
OPEX / lb of Sulphur removed		BASE CASE		BASE CASE + $6.2 [C]		BASE CASE + $32 [C] [D]		Not evaluated. OPEX > BASE CASE

[A] Electrical consumption assumed same with all options.

[B] OPEX excludes spent sorbent removal and treatment

[C] Catalyst cost based on SulfaTrap – R7Q, R7H & R8HB annualized cost of replacement provided by vendor.

H. BAT EVALUATION CONCLUSIONS

It can be observed from the BAT evaluation summaries, the Pretreatment option (Scavenger - Sulfatreat) for sulphur removal does result in increased overall impact to environment. Though, the SO_2 emission is reduced, more catalytic waste contributed as land waste after neutralization and within EU Directive 2008/98/EC, this catalyst waste can be interpreted as HAZARDOUS.

The post treatment through wet scrubbing, is observed to be most non economical and generate additional continuous effluents (both as liquid effluent and solid waste). Hence this option is not recommended.

Hence, based on BAT evaluation, considering the overall environmental impact, it is recommended that incineration through thermal oxidiser (base case design) is retained without any sulphur removal technique.

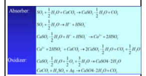
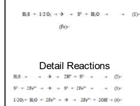
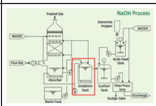
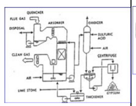
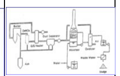
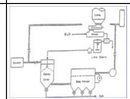
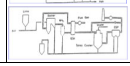
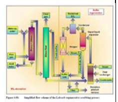
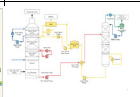
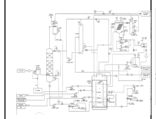
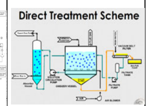
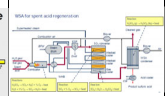
With only incineration through thermal oxidiser, the project specification on SO_2 concentration as indicated in Table 5 is not achievable. Hence the following revised project specification for acid gas incineration is proposed.

Table 10- Proposed Project Specification for Acid Gas Thermal Oxidiser

Pollutants	***Unit*** [A]	**Earlier Thermal Oxidiser Specification**	**PROPOSED Thermal Oxidiser specification**	**Justification for Changes**
Carbon Monoxide	*g/Nm3*	-	0.100	BAT Evaluation
Carbon Dioxide	*g/Nm3*	-	-	
Hydrogen Sulphide	*ppmv*	5	5	
Unburnt hydrocarbons	*g/Nm3*	-	-	
Nitrogen Oxides (@ Nitrogen Dioxide)	*g/Nm3*	0.150	0.100	BAT Evaluation (for new unit)
Sulphur Dioxide	*g/Nm3*	0,02	-	MD 118 11 Petroleum Works + BAT Evaluation
VOCs	*g/Nm3*	0,02	0.035	MD 118 11 Petroleum Works
Total particulates	*g/Nm3*	0.100	0.100	MD 118 11 Petroleum Works
Sulphur recovery efficiency	*%*	-	-	Not Applicable as inferred from BAT Evaluation
Benzene	*g/Nm3*	0,001	0.001	
Oxygen	*%*	-	-	-

[A] In absence of specified reference temperature 0°C may be taken as reference temperature for emission concentration

Attachment 1 - BAT Qualitative Assessment Table (provided in spreadsheet)

Type										Pre-Treatment			
Option No	1	2	3	4	5	6	7	8	9	10	11	12	13
Name	Seawater Scrubbing (Non Regenerative)	Caustic Wet Scrubbing (Regenerative)	Limestone Wet Scrubbing (Non Regenerative) (End product: gypsum)	Wet Scrubbing - Magnesium Hydrate (Mg(OH)2) (Non Regenerative)	Ammonium Sulfate Recovery (NH3) (Non Regenerative) (The end product: ammonium salt)	Spray Drying	SO2 Wet Scrubbing (Regenrative: Na2SO3) (SO2 Recovery)	SO2 Wet Scrubbing (Regenerative: sodium phosphate) (SO2 Recovery)	SO2 Wet Scrubbing (Regenerative: Amine) (SO2 Recovery)	H2S Scavenger (Non Regenerative)	Mini SRU Bio SRU	Mini SRU REDOX Process	Sulfuric Acid process
BAT reference					Walther		Wellma-Lord	LABSORB	CANSOLV	Sulfur Treat: schlumberger, Cu/Zn/MnO2 adsorbent	THIOPAQ	LoCAT Sulferox	WSA
Remarks			Handling of gypsum shall be considered.		Handling of ammonium salt shall be considered.		Handling of product SOx shall be considered.	Handling of product SOx shall be considered.	Handling of product SOx shall be considered.	Low CAPEX. OPEX moderate. Used in Liwa plastic.	Handling of elemental Sulferx shall be considered.	Handling of elemental Sulferx shall be considered.	H2S and SOx can be recovered by H2SO4. Normally used for large quantity of H2S. In this PJ, the feed H2S and SOx quantitiy is very small.
Performance NG if 0.02g/3 is not achievable	NG	99%+	(92-98%)		(>88%)	NG (> 92%)	X (98% (100g/Nm3))	(> 85%)	(98%)	> 98%	> 98%	> 98% (as H2S LoCAT)	> 98%
License required or not	N	N	N	N	?	N	Y	Y	Y (Shell)	N	Shell	MERICHEM (LoCAT) SHELL (Sulfrex)	HTAS
Bi-Product NG if it can not be handled	N/A	134 kg/D as Na2SO4 1.9 m3 as 7% Na2SO4 bleed water	162 kg/D as Gypum		125 kg/D as (NH4)2SO4	No bi-product	NG SO2 can not be re-used or disposed.	NG SO2 can not be re-used or disposed.	NG SO2 can not be re-used or disposed.	N/A	134 kg/D as Elememtal Sulfur	134 kg/D as Elememtal Sulfur	Concentrated H2SO4 HP Steam(Not used)
Waste	Spent sea water (low pH)	Bleed water containing Na2SO4 to OD2	waste water		N/A (?) Ammonia?	spent sorbent from bag or ESP	waste water	waste water	waste water	- spent adsorbent - Off gas (incinerator is required.)	-Bleed water - Off gas (incinerator is required.)	-Bleed water - Off gas (incinerator is required.)	
Foot print S; can be accomodated without major impact M; can be accomodated with some modification L; Difficult to accommodate in current plot plan	M	L	L	L	L	M	Not evaulated	Not evaulated	Not evaulated	S	M	M	L
Evaulation 1 = Good 2 = Acceptable 3 = Not acceptable	3	2	2 Similar with Caustic but less common. Evaluation will follow caustic.	2 Similar with Caustic but less common. Evaluation will follow caustic.	2 Similar with Caustic but less common. Evaluation will follow caustic.	3	3	3	3	1	2	2	3
Method		SO2 + 2NaOH → Na2SO3 + H2O SO2 + Na2SO3 + H2O → 2NaHSO3 NaHSO3 + NaOH → Na2SO3 + H2O Na2SO3 + ½O2 → Na2SO4			SO2 is absorbed by spray injection of aqueous ammonia, yielding ammonium sulphite. The sulphite is subsequently oxidised to sulphate. The ammonium salt solution from the scrubbing section is concentrated in an evaporation unit and granulated. The end product is a marketable fertilizer.	Pneumatically inject powdered sorbent directly in the furnace, the economizer, or downstream ductwork. The dry waste product is removed using particulate control equipment such as a baghouse or electrostatic precipitator (ESP).	The process is based on sodium sulphite/bisulphite equilibrium. Adsorption: Na2SO3 + SO2 + H2O → 2NaHSO3 2NaHSO3 → Na2S2O5↓ + H2O Regeneration: Na2S2O5 + H2O → 2NaHSO3 2NaHSO3 → Na2SO3 + SO2 + H2O	Labsorb generates a >90 % concentrated SO2 stream that can be used as feed to a SRU or a sulphuric acid plant. The scrubbing solution is regenerated using low-pressure steam, which virtually eliminates the discharge of liquid effluents from the scrubber.	The gas to be treated is first saturated in a water prescrubber and is then contacted with the amine solution. The amine solution is regenerated by steam stripping. A slipstream of the amine needs to be purified to prevent the accumulation of salts. The scrubbing by-product is water-saturated SO2 gas recovered by steam stripping.		H2S + OH- → HS- + H2O H2S + CO32- → HS- + HCO3- HS- + 1/2O2 → 1/8S8 + OH- HS- + 2O2 + OH- → SO42- + H2O	Overall Reaction  Detail Reactions	
Schematics						 							

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